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(*Dating from the Foundation of the Society*) :—

"The Society will not be responsible for the accuracy of the statements or conclusions contained in the several papers in the Journal, the authors themselves being solely responsible."

THE JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND

AGRICULTURAL LONG-TERM CREDIT FACILITIES IN GREAT BRITAIN.

UNTIL the last decade it was a matter of regret that British farmers enjoyed no facilities whatsoever for the State-aided purchase of their farms, such as their fellows in most overseas countries (notably the United States, Germany and Denmark) readily obtain through their well-established land banks. Ultimately, with the passing of the Agricultural Credits Act of 1928 (applicable to England and Wales), followed by the Agricultural Credits (Scotland) Act, 1929, this long-standing reproach was removed. This legislation was the result of prolonged agitation on behalf of those one-time tenant farmers who, rather than see their farms sold over their heads, had felt obliged to buy their farms just after the War; in many cases they had done so with money borrowed at high rates of interest. In each case, the Act was intended "to secure . . . by means of the formation of a Company and the assistance thereof out of public funds, the making of loans for agricultural purposes on favourable terms, and to facilitate the borrowing of money on the security of farming stock and other agricultural assets. . . ."

We are not concerned here with the Second Parts of the Acts which, both in England and in Scotland, were meant to improve agricultural *short-term* (or productive) credit facilities; in any case these parts of the Acts have proved dead letters. But Part I of each of the Acts, dealing with long-term credit, envisaged the formation, in each country, of a Government-subsidised concern designed to attract funds from the investing public, which funds could be lent out at relatively low rates of interest to farmers desirous of buying their farms. Repayment was to be made by instalments spread over long periods, in much the same way as the urban householder repays a building

society which has enabled him to buy his house. The purpose of this short article is to review the progress made under the Acts and to estimate the success achieved during the past ten years. There is no intention of making invidious comparisons between the two countries, but merely of stating the plain facts.

I.—The Financial Structure of the Two British Credit Corporations.

The incorporation of the Agricultural Mortgage Corporation Ltd., followed very shortly after the passing of the 1928 Act. Operating of course in England and Wales only, with its head-quarters in London, it commenced business early in 1929, concerning itself almost exclusively with "making loans or advances on first mortgages of agricultural or farming estates, properties, or lands. . . ." Its funds are derived from three sources: a Government loan supplemented by an annual contribution to its administrative expenses for 10 years; share capital held by English joint-stock banks; and debentures issued to the public.

(i) *Government Funds.* These comprise :—

(*a*) A loan of £650,000, free of interest for 60 years, from the Treasury; the Treasury, under the 1928 Act, was empowered to make advances to the Corporation up to a maximum of £750,000, provided that such advances did not at any time exceed the paid-up share capital of the Corporation. This loan is not available for making advances to farmers, since, under the express provisions of the Act, it must be invested in Government securities, thus forming a "guarantee or security fund for further securing the debentures or debenture stocks of the Company."

(*b*) In addition, the Ministry of Agriculture and Fisheries has been contributing £10,000 per annum towards the costs of administration of the Corporation since its inception, although this source of revenue ceases this year (1938).

(ii) *Share Capital*, issued and paid-up, amounting to £650,000. This is held by the Bank of England and four of the "Big Five" English joint-stock banks, viz., Lloyds, Barclays, The National Provincial, and the Westminster Bank, together with one or two smaller ones: the Midland Bank has always remained aloof. Interest on these shares, in accordance with the Memorandum of Association, must not exceed 5 per cent. per annum.

This active co-operation of the banks, whose nominees are on the Board of Directors, ensures that the affairs of the

Corporation shall be managed with due regard to the high traditions of financial prudence of the banks themselves.

It was necessary to overcome the City's proverbial reluctance to invest large sums of money in agriculture, which differs fundamentally from all other British industries; it differs in the smallness of the business unit; in the lack of effective organisation amongst its multiplicity of relatively small capitalists; in the slowness of its capital turnover; in the absence of joint-stock enterprise; and in the ever-present risks of inadequate financial returns to the farmer owing to vagaries of the weather, to unfavourable world price movements, and to other factors largely outside his control. Great care was therefore taken in the drafting of the Constitution of the Corporation. As has already been pointed out, the Treasury voted a substantial sum as a guarantee fund, which, in the absence of other reserves, would go far towards reassuring the City of the sound foundations upon which the Corporation's financial structure was to be built; this solid basis would be further emphasised by the limitation of interest on share capital and by enlisting the active collaboration of the banks in its management; equally important was the fact that any advances to be made on the security of agricultural lands, etc., were not to exceed *two-thirds* of the value of the property mortgaged, as certified by an independent surveyor or valuer; the advances were, moreover, to be repaid within a period not exceeding 60 years from the date of issue.

(iii) *Debentures* issued to the public and so far totalling £10,500,000. In view of the safeguards above mentioned, it is not surprising that the Corporation's issues of debentures have proved popular in the City, especially with trustees, insurance companies, etc. Its first issue of £5,000,000 5 per cent. Debenture Stock, redeemable between 1959 and 1989, was made in June, 1929, and was readily absorbed; a second issue of £3,500,000 of the same stock followed in May, 1930. And when, in April, 1932, the demands made upon the Corporation by the agricultural community necessitated additional loanable funds, more favourable money-market conditions enabled it to borrow a further £2,000,000 in 4½ per cent. Debentures at the issue price of 95, repayable at par between 1961 and 1991. At the time of writing[1] both these stocks stand at substantial premiums.

In Scotland it was confidently expected that similar developments would follow immediately after the passing of the 1929 Act. Owing to prolonged negotiations amongst the leading Scottish joint-stock banks, however, it was not until January, 1933 that the Scottish Agricultural Securities Corporation Ltd. was incorporated. It has carried on business from Edinburgh

[1] 29th July, 1938.

since 1st September, 1933. Although on a much smaller scale than its sister concern in London, it draws its funds from the same three sources and under very similar conditions—from the Government, certain joint-stock banks, and the public. It is financed by means of :—

(i) *A loan of* £100,000 from the Department of Agriculture for Scotland, free of interest for 60 years, invested in Government securities, and used solely as a guarantee fund; again, the Department is to make an annual grant towards the Corporation's costs of administration during its first ten years, the sum being £1,750.

(ii) *Share Capital of* £100,000 held in equal portions by the Royal Bank of Scotland, the British Linen Bank, the Commercial Bank of Scotland, Ltd., and the National Bank of Scotland, Ltd.; the other four Scottish joint-stock banks have no financial interest in the Corporation.

As in England, interest on share capital is limited to 5 per cent. per annum. The directorate comprises the general managers of the four shareholding banks (one of whom acts as chairman) together with a prominent Scottish agriculturist nominated by the Treasury.

(iii) *Debentures* issued to the public, amounting to £500,000.

The long delay which preceded the incorporation of the Scottish Agricultural Securities Corporation served one very useful purpose. As a result of the lower rates of interest ruling after the Government's large-scale conversion operations in 1932, it was able to obtain its necessary loanable funds in December, 1933 on much more favourable terms than its English counterpart. £500,000 was raised without difficulty in $3\frac{1}{2}$ per cent. Debenture Stock issued at 95, repayable at par between 1963 and 1993; no further issue has yet been made. This stock is at present[1] quoted on the Stock Exchange at about par.

Thus, through these two sources, £$11\frac{3}{4}$ millions have been made available for long-term loans on the security of farm properties in Great Britain—£11,150,000 in England and Wales, and £600,000 in Scotland.

II. Raising a Loan.

The procedure necessary to obtain a loan is straightforward enough, although some farmers appear to have difficulty in furnishing all the information required of them. In England and Wales, application is made through any one of the *shareholding* banks; in Scotland through *any bank*. In each case the would-be borrower completes the Corporation's application

[1] 29th July, 1938.

forms giving, in confidence, full particulars of the agricultural property to be mortgaged and the amount and period of the required loan, furnishing also details of his own farming experience and such other personal information as will help the Corporation to decide whether or not, from their point of view, he may be regarded as credit-worthy; each individual applicant is treated perfectly fairly on his own merits. "Generally speaking, if he is able to provide one-third of a reasonable purchase price, and has command of the necessary capital to stock and cultivate the lands in a reasonably efficient manner" no obstacles are put in the way of an intending borrower.

A competent practical valuer deputed by the Corporation visits the farm, and he, after a thorough investigation of its condition and potentialities, assesses the value of the property. Up to this point, the only expense incurred by an applicant in Scotland is the cost of obtaining the valuation (which must be paid by him whether the loan is ultimately granted or not); this amounts to £1 1*s*. per £1,000 valued, with a minimum fee of £4 4*s*., plus the travelling and other out-of-pocket expenses of the valuer. In England and Wales the valuation fee works out at considerably more, even though it is on a diminishing scale, decreasing proportionately as the amount of the valuation increases. Certain other legal costs are in all cases necessary before the loan is completed, but in the case of England and Wales the mortgagee's legal costs are borne by the Corporation out of its general funds. Speaking very roughly, the cost of obtaining a loan of between £1,000 and £10,000 (including valuation fees, stamp duty, conveyancing fees, etc.) may vary between extremes of $\frac{3}{4}$ per cent. and $1\frac{1}{2}$ per cent. of the sum borrowed in Scotland, and between 1 per cent. and 2 per cent. in England and Wales, large loans being raised relatively more cheaply than small ones; the cost of obtaining a loan below £1,000 is however, higher than the percentage figures given.

Loans may be granted up to a sum not exceeding two-thirds of the valuation of the property made by the Corporation's valuer, and are repayable by equal half-yearly instalments of principal and interest combined, spread over any period up to 60 years. Although most of the loans are taken out for round periods of 10, 20, 30 years and so on, they can be arranged, to suit the special circumstances of a borrower, for any broken period up to 60 years.

In Scotland, all loans have been based on an effective return to the Corporation of $4\frac{1}{2}$ per cent. per annum (1 per cent. more than the interest paid to its debenture holders) and it is on this rate that the actuarial tables for the repayment of loans have been drawn up. For Scottish borrowers a loan of £100 from the Scottish Agricultural Securities Corporation is repayable in

equal half-yearly instalments, including both capital and interest, at the undermentioned rates :—

Period of loan	60 yrs.			50 yrs.			40 yrs.			30 yrs.			20 yrs.			10 yrs.		
Half-yearly	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
instalment	2	10	0	2	12	6	2	16	8	3	4	2	4	0	0	6	9	5

Thus, with a payment of £5 a year for 60 years, or of £8 a year for 20 years, a loan of £100 would be completely wiped out. In England and Wales, those who raised loans through the Agricultural Mortgage Corporation during the first five years or so of its existence paid, and still pay, on a basis of 5 per cent. interest, *i.e.* ½ per cent. more than in Scotland; but as from 16th April, 1934, *new* borrowers have obtained loans calculated on a basic lending rate of 4¼ per cent. interest, which works out at about 2/6 per £100 per half-year below the instalments set out above. Incidentally this rate of interest is less than that actually paid by the Corporation to its debenture holders.

A purely hypothetical case based on the rates applicable to Scotland may help to crystallize the above details. Let us suppose that a 35-year-old Scottish farmer occupying a good 250-acre mixed farm rented at 30/- an acre (£375 p.a.), is given the option of buying his farm at 20 years purchase, *i.e.*, for £7,500, which he regards as a very advantageous offer. He is able to put down £2,500 cash—the necessary one-third of the purchase price, and, after successfully negotiating for a loan for the remaining £5,000 from the Scottish Agricultural Securities Corporation, whose valuer reports favourably on the farm, he closes with the offer. The loan is to be repaid over a period of 30 years, which, at £3 4*s.* 2*d.* per cent. half-yearly, means a combined annual payment of interest and principal of £320 16*s.* How does he stand financially year by year, as compared with his previous position ?

Naturally, he must realise certain investments in order to put down his deposit of £2,500, depriving himself meanwhile of the interest which they may have been yielding; assuming a minimum return of 3½ per cent. p.a., this could not be less than £87 10*s.* per annum; in addition, from now on, he incurs Schedule A property tax;[1] the repairs, maintenance, and insurance of his property; owner's rates; and possibly stipend (or tithe redemption) too. In such circumstances the farmer

[1] It should not be overlooked that, in the circumstances postulated above, the borrower would obtain relief in respect of Schedule A to the extent of the mortgage interest paid. It therefore follows that the actual liability under Schedule A is the *net annual value less the amount of mortgage interest paid.* Prior to taking the mortgage referred to, Income Tax under some other Schedule would have to be paid on any interest, dividends or profit earned by the £2,500; now that the mortgage has been taken, Income Tax under Schedule A is paid on approximately the equivalent amount.

must budget for a heavier total annual cash outlay (with the half-yearly instalments to the Corporation as the largest item) than he formerly incurred as a rent-paying tenant. This of course would not apply in all cases, for a great deal depends on the proportion of the purchase price which the borrower is able to put down in cash himself, and on the length of the period over which repayment of the loan is spread.

The comparison set out above would in point of fact be incomplete if one failed to stress one very important fact, namely, that, over the 30-year period, our hypothetical borrower accumulates out of his half-yearly payments an additional investment in property totalling £5,000—equal to a steady flat-rate saving of £166 13*s*. 4*d*. a year. (Actually, of course, as in the operations of building societies, the half-yearly payments at the beginning of the period of the loan consist almost wholly of interest, the capital repayment being negligible; towards the end of the period of the loan the reverse is the case.) No doubt this regular "saving-out-of-income" plan acts as an additional spur to the borrower to be punctual with his instalments.

But in every case the inducements offered to the would-be buyer are very real. Even whilst he is merely in process of buying by means of half-yearly instalments, he enjoys the valuable stimulus which ownership alone can give, arising from complete security of tenure and complete freedom of action on his farm—a boon which any spirited enterprising farmer will readily appreciate. Moreover, by dealing with a public corporation founded specifically for the long-term financing of agriculture, he knows quite well that he will never be confronted with an arbitrary demand calling in his loan at an inconvenient time (such as a borrower through private sources might perhaps have to face) and in the unforeseen event of his finding difficulty in meeting his half-yearly payments at some future date, he has the reassuring thought that he will then receive every consideration from both directors and officials of the Corporation, who have a very real understanding of the farmer's business problems. He has, too, the satisfaction of knowing that, once he has embarked on his plan of regular systematic saving, he is effecting a safe investment, whilst every payment made takes him one step nearer the very desirable goal of complete independence for himself and his family.

III.—Utilization of the Long-Term Credit Facilities.

Extensive use has been made of the long-term credit facilities offered both in England and in Scotland. Borrowers are of three main types:—

(*a*) Occupying-owners desirous of re-financing an existing mortgage on more favourable terms;

(*b*) Tenant-farmers desirous of buying their farm so as to guarantee their family security of possession; and

(*c*) Non-farmers, actuated by a variety of motives, desirous of buying one or more farms.

To some extent, the gradual and piecemeal disintegration of some of our large agricultural estates—the continuance at a slower tempo of a process which was much more in evidence in the early post-War years—is a contributory factor in the tendency towards occupying ownership in Britain. Heavily taxed, sometimes financially embarrassed by a sharp succession of death-duty payments, and often quite unable to contemplate the heavy outlay necessary to put their farm properties into "good and tenantable repair," large landowners are in some cases selling off portions of their estates. A well-established tenant, or some other business man with a certain amount of capital behind him, may thus be given an excellent opportunity to buy a farm at a very reasonable price.

What measure of success has attended the efforts of these long-term credit institutions? Let us take the Agricultural Mortgage Corporation first. Its last balance sheet shewed that on March 31st, 1938, £8,673,547 was outstanding in loans on first mortgage on agricultural land; and the chairman's annual report for the year stated that the total amount advanced by it since its incorporation amounted to £12,416,218, secured on 846,860 acres of land, which, with the farmhouses and buildings erected on it, was valued at £19,541,826. A further cause for gratification was that geographically—as was wont to be pointed out at the earlier annual general meetings—the loans were well distributed over the whole country, with the counties of Yorkshire, Lincolnshire, Kent, Somerset and Norfolk shewing up rather prominently; in addition, as was stated in 1933, small borrowers were making good use of the Corporation's facilities, for 26 per cent. of its loans at that time were for sums smaller than £1,000, whilst by far the greater part of the advances which had then been granted were based on the security of farms of under 200 acres. In 1938 scheduled payments were, as always, being promptly met, for "93·9 per cent. of the amount which fell due had been received within seven days of the close of the Company's financial year." Foreclosures have been few, and are resorted to only "in cases where there appears to be no possibility of the mortgagor being able to regain his position." It was not, in fact, until 1936–37 (as the balance sheets shew) that such a step had proved necessary with any of the Corporation's clients, "Freehold Land" and "Farming Stock" belonging to the Company making their first appearance in its balance sheet for that year; the latest figures for these items (which include purchases) are £110,000 and £33,000 respectively.

Although at first sight this record of achievement might appear to be highly satisfactory, closer investigation reveals that, after a very impressive "run" in the early 'thirties, the corporation (to continue the metaphor) has had to buffet against strong headwinds and has latterly made very little headway, and it seems that its facilities have now, to some extent, lost their appeal. Within little more than three years after it commenced business (*i.e.*, up to 31st March, 1933) its advances to farmers totalled rather more than £10,000,000, yet in the past five years the new loans have amounted to less than £2,250,000 all told. Moreover, this latter sum falls very considerably short of the amount of "special repayments" received by the Corporation during the same period, *i.e.*, "repayments accepted otherwise than is provided for in the mortgage contracts;" in other words, new loans are not keeping pace with these rather embarrassing pre-payments, and the disparity between them has been particularly wide during the past two years. This marked slowing down in the active utilization of its resources traces back to the central difficulty which has confronted the Corporation during the past five years—the relative rigidity of the terms which, in order to cover the interest payments to its debenture holders (from whom the greater part of its loanable funds were obtained), it can offer to the agricultural community. Even though it "was not set up primarily as a profit-making institution," it must still maintain such terms for its loans as will at least enable it to cover its own fixed interest charges, which amount to over £500,000 a year, as well as its costs of administration. The fall in interest rates following the Government's large-scale conversion operations in 1932 has, temporarily at any rate, sterilized a very considerable volume of business upon which the Corporation could reasonably have counted; as matters now stand, potential borrowers feel that they will probably have little difficulty in obtaining more favourable terms elsewhere. From this somewhat uncomfortable situation there seems little likelihood of any early relief, for both the 5 per cent. and the 4½ per cent. Debentures of the Corporation are long-dated securities, neither of which falls to be redeemed, at the very earliest, before the 30-year period commencing 1959. Yet it seems anomalous that, in an era of cheap money, when investment in land is more attractive than usual, the would-be owner-occupier is denied an opportunity of enjoying the most favourable terms of purchase *plus* maximum security, even from a concern which was specifically established to provide them.

As it is, one sees the inevitable repercussions of this smaller volume of applications for loans in the marked increase in the Corporation's "idle funds," and in a coincident fall in the annual profits. For lack of an outlet in agriculture, the liquid assets

of the Corporation, viz., "Other Investments" (as distinct from those representing the Guarantee Fund of £650,000) and "Cash at Bankers," have swollen very considerably during the past six years, as the following figures from the balance sheets shew :—

——	1933.	1934.	1935.	1936.	1937.	1938.
	In Thousands of £'s.					
Other Investments at cost	1,406	1,569	1,424	1,521	674	1,882
Cash in hand and at Bankers	116	45	220	209	1,414	305
TOTALS ..	1,522	1,614	1,644	1,730	2,088	2,187

It will be seen that at 31st March, 1938, there was well over £2,000,000 still awaiting investment in agriculture—a considerably larger sum than the total proceeds of the last issue of debentures made six years earlier.

The low rate of interest earned on temporary investments, and the increasing difficulty experienced by the Corporation in finding employment for its surplus funds, are naturally reflected in the financial results of the past few years. Hence, although a dividend of $2\frac{1}{2}$ per cent. on the share capital in the hands of the joint-stock banks was declared during each of the first five years, no dividend has been declared for the past three years, the directorate having wisely devoted all profits to consolidating the financial position of the undertaking. It is obvious that, to quote the Chairman's own words, the Directors "would be very glad to see a considerable increase in the volume of applications for the facilities" they are offering to farmers.

The progress of the Scottish Agricultural Securities Corporation in Scotland has been steady rather than spectacular. It was designed on a much more modest scale than its English counterpart, owing no doubt to the far smaller area of agricultural land in Scotland and, consequently, the much smaller magnitude of the problem with which it was expected to have to cope. Its last published balance sheet shewed that, at 31st March, 1938, its loans on first mortgage totalled £605,871. Since its incorporation its total loans have amounted to £631,005, secured on 101,329 acres of land valued at £1,044,545. Far from there being any considerable volume of surplus funds awaiting investment, it has lent up to the limit of its available resources. During the last year for which the figures are available it was working on a bank overdraft, which amounted to £31,802 at the close of the financial year, whilst it still continued to increase its advances to the agricultural community.

It is of interest to note from the Scottish Corporation's annual reports that in its early days the loans granted were "largely used for the purpose of replacing existing loans," whereas of late years "in the majority of cases they were furnished, not for the replacement of bonds, but for the purchase of farms." On this aspect of its activities the sister concern has, perhaps designedly, maintained an unbroken silence.

Geographically, the loans of the Scottish Corporation are well distributed over the face of Scotland—among the rearing and feeding farms of the north and north-east, the dairy farms of the west and south-west, and the arable farms of the east and south-east; one county—Aberdeenshire—stands out by reason of the exceptional demand which it has made upon the Corporation's facilities. This is a result of the rather special opportunities which have offered themselves to would-be owner-occupiers of recent years in one or two parts of the county. An analysis of the mortgages granted throughout Scotland up to the end of July, 1938, shews that 38 per cent. of the total amount was in sums below £1,000, rather more than one-half in sums between £1,000 and £5,000, and only 10 per cent. of the total in sums of over £5,000. As further evidence of the small owner's appreciation of the services of the Corporation, it may be mentioned that 27 per cent. of its mortgages were granted on the security of farms less than 100 acres in extent, and a further 27 per cent. on farms between 101 and 200 acres. It is also rather noteworthy that fully one-third of all these long-term loans were taken out for the maximum period of sixty years (no doubt with the object of making the half-yearly instalments as light a burden as possible), whilst terms of 20 years and 30 years have also proved popular with borrowers; both of these latter periods would give an average family man, in his forties, a reasonable expectation of living till the proud moment when he would be able to hand over the title deeds of his farm, clear of all encumbrances, to his son.

The Scottish Agricultural Securities Corporation has been fortunate with its borrowers, for there are no arrears either of interest or capital repayment outstanding and, so far, there has been only one instance of a security subject having to be realized. There have been some "special repayments" approved by the directors during the past three years, but these have neither been very large nor very numerous. It will not have escaped notice, however, that the Corporation has not yet received a volume of applications for new loans sufficient to impel it to make a second issue of debentures to the public; broadly speaking, indeed, the demand made upon its facilities has shewn the same trend as in England, *i.e.* a spate of inquiries in the early days (which, judging by Scottish experience one may surmise was largely concerned in both countries with the re-financing of

existing loans), followed by a slowing-down process—more marked in England than in Scotland—once these early applications had been dealt with. Undoubtedly the fall in rates of interest ruling in the money market must have tended to diminish the volume of business which the Scottish concern might reasonably have expected to attract. It is to be observed also that the directors, acting with almost prophetic insight, have made one notable departure from the precedent established by the larger and more experienced English Corporation; they have wisely contented themselves with consolidating the financial position of their Corporation, and they have never yet declared a dividend on their share capital. So long as it had any surplus funds, however, it laboured under one self-imposed handicap peculiar to itself. Its directors, probably with a view to obviating all risk of capital depreciation of any securities they might conceivably purchase, with true Scots caution elected to place such funds on deposit with its bankers, and from this practice they have never deviated. The Agricultural Mortgage Corporation, on the other hand, invests such funds in Government securities—a policy which, besides giving it a very desirable measure of elasticity in its financial control, has always provided it with an additional source of revenue; this revenue, particularly in the early years, materially improved the appearance of the credit side of the annual profit-and-loss account.

IV. General Conclusions.

It is increasingly apparent that in the direction of long-term agricultural credit institutions, such as the Agricultural Mortgage Corporation and the Scottish Agricultural Securities Corporation, many intricate and highly technical financial problems arise—the method of obtaining the necessary loanable funds, the terms and conditions upon which loans may be granted, and the supervision of day-to-day policy. In recent years the repercussions of world economic conditions have sharply accentuated these problems, which in turn have caused many members of the agricultural community to adopt a somewhat critical attitude towards them. The crux of the whole problem is that the rates of interest on the debentures raised in "blocks" prior to, or during, a period of falling interest rates, have petrified the lending terms during a period of great agricultural uncertainty when fluidity was highly desirable.

"With regard to existing mortgages," said the Deputy Chairman[1] of the Agricultural Mortgage Corporation in April, 1934, "it is not possible for us to make any immediate change in the rates under which these loans were contracted. Indeed, the same causes which enable us to reduce our rates for future

[1] Sir Otto Niemeyer at the Annual General Meeting.

loans compel us to insist more strictly on the terms of our contracts with existing borrowers."

Both corporations borrow long, and lend long: their borrowing rate must, on the face of it, be kept in very close relation to their lending rates. We must recognize that only a financial expert can determine the terms and conditions which will make an issue of debentures sufficiently attractive to the public; yet it is plain to all that the 30–60 year debenture, as a means of financing long-term agricultural credit, is open to criticism on the ground that it is far too inflexible. It is easy to be wise after the event, but it is clear that machinery could have been devised that would have kept the funds of the corporations revolving, and would have enabled them to lend on terms more closely related to current money-market conditions.

The operations of the two corporations might have been expected to make for a pronounced swing towards occupying ownership, but one may hazard a guess that, in fact, the proportion of agricultural land farmed by owner-occupiers in England and Wales and Scotland (still approximately one-third of the total area of farm land) has not been materially altered. The cynic might be tempted to assert that the Corporations have done little to help the farmer, and have merely enabled the banks to rid themselves of a number of unwanted agricultural mortgages which they had been carrying. The accusation is unjust, but the problem remains. We have in existence two State-aided long-term agricultural credit institutions with funds at their disposal, with staffs trained in the technique of long-term loans, yet handling a relatively small amount of business. How are their terms to be adjusted, so as to induce more farmers to utilize their resources? Is this practicable? Is it desirable?

Should additional Government assistance be sought to enable the two corporations to scale down their basic lending rates? To-day the Agricultural Mortgage Corporation, more especially, is in a somewhat similar position to that which faced the sugar-beet industry a few years ago; contrary to the Government's expectations at the time of the passing of the Beet Sugar (Subsidy) Act of 1924, the industry was found, after ten years, to be quite unable, owing to a severe and unexpected fall in the world price of sugar, to support itself without a subsidy. Even if the Government should see fit to continue beyond the scheduled period of ten years its contribution of £10,000 per annum towards the Corporation's administrative costs—a very bold assumption—this would not nearly suffice to make the Corporation an effective instrument in the re-moulding of our agricultural organization. A much more substantial measure of Government financial assistance would be necessary to enable both the English and Scottish Corporations to cut their basic rates of interest by one per cent. per annum, which is the minimum reduction necessary.

Actually, up till now, the combined annual cost of these two concerns to the Treasury has not been large, even if we include the temporary loss of interest on the sums advanced to form the Guarantee Funds. But any question of a subsidy, considerably in excess of the present one, at once raises very controversial issues; even if such an increased contribution from the Government materialized, and enabled both Corporations to cut their lending rates, it is debatable whether, under present-day conditions, these could be so far reduced as to tempt many genuine tenants to buy, without at the same time risking the grave abuse of the scheme by speculators in land. Moreover, the question raises the other and much wider problem of the place of the owner-occupier in the economic organization of British agriculture. It may be granted that there are many farms, and even relatively large areas, in this country, whose inherent potentialities have hitherto remained under-developed and in regard to which there is some truth in Arthur Young's oft-repeated dictum that "The magic of property turns sand into gold." But there is still, from the wider standpoint of the nation, no convincing or unchallengeable evidence that a widespread change-over to occupying ownership would so increase the productivity of our land as to lead to a much greater measure of self-sufficiency with regard to our national food supplies, or to the attainment of other objectives desirable from the national point of view. Hence it is doubtful whether additional State assistance will be forthcoming.

We may sometimes feel rather overawed by the imposing structure of long-term agricultural credit in other countries—in the United States of America for instance—but this has its roots in a social and agricultural history entirely different from our own. We have, at least, been happily spared the acute problem of mortgage-debt adjustment which confronted the hard-hit owner-occupiers of the United States, New Zealand, Denmark and other European countries during the worst of the agricultural depression, when *ad hoc* legislation had to be introduced to alleviate their position. It is, moreover, not easy to decide whether an agricultural economy based on a national system of occupying ownership would prove more stable or more resistant to a rapid fall in the prices of agricultural products than our existing tenancy system. In this continuing uncertainty it seems unlikely that, apart from drastic intervention on the part of the Government, we shall see any large-scale extension of the activities of our two long-term credit Corporations in the near future.

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THE STORY OF THE BRACKEN FERN.

There must be very few people who have not seen Bracken, now one of the world's most widely distributed plants. Unfortunately this "fern" is at the same time one of the most persistent and prolific species of plants; one of the most injurious weeds of farm land; one of the most difficult to control; and one that very many farmers appear to ignore because they regard its destruction as more or less hopeless, or too costly in view of the low annual value of the land it occupies.

It is proposed to discuss in the following pages, the history, life, distribution and control of this very injurious weed, but it is desired at the outset to emphasize the view that if much bracken-infested land is worth no more than 2*s*. 6*d*. to 3*s*. 6*d*. per acre, such a sum by no means represents the rental value of the same land after the bracken has been destroyed. It is, therefore, rather unreasonable to assume that, because the eradication of the bracken will cost more than the rental value, it is not an economic matter to incur such cost. One need only remind the tenant or landowner that it is a usual practice to spend far more than the annual value on tillages, on fertilizers and on seed; and there is a spot in the Channel Islands where, owing simply to the situation, it pays to incur a rent of £25 per acre and, to all intents and purposes, create the soil in which the potato crop is grown. Such a situation is hardly likely to apply to a bracken-infested area, but it needs to be recognized that even bracken-covered upland grazings may be viewed in a very different light after they have been cleared and are growing a respectable bite for sheep and cattle.

It will be shown below that the reasons for the great increase in bracken in this country in recent times include the replacement of cattle by sheep; the reduction of crofters, and the consequent falling down to grass of land previously cultivated; a reduction in "high farming" owing to the competition of imported food, falling prices and lower profits; a series of wet seasons that have probably been very favourable to the spread of the plant by spore growth; the fact that bracken is but little cut now-a-days for bedding or thatching, dyeing or potash making; and the greatly reduced staffs on estates during the period of the Great War.

It is true that bracken is beautiful at almost any time. Stapledon has written poetically of "heather fell":

> "For sheer loveliness and wonderful mingling of colours, with bracken predominant in one place, heather or gorse in another, heather fell must rank as quite one of the most beautiful features of our British landscape. Glorious early in the year when the bracken is unfolding and the gorse a golden blaze, almost more

glorious when, in August, the heather is in bloom, but gorgeous beyond description in the early autumn, when the bracken and birch are turning and the autumn gorse flowering while still the the heather holds purple "

Nevertheless, Stapledon also recognizes the dire loss due to the extent of the areas occupied by this insidious foe of the farmer.

Old ideas. In olden times it was not unusual to examine a plant or a part of it for some resemblance to a well-known object. Bracken is not exempt from this idea, and it was considered that a transverse section of the frond stalk suggested the figure (formed by the fibro-vascular bundles) of an eagle with its wings spread. Hence the name *Pteris aquilina* (*Pteron*=wing, and *aquila*=an eagle.) The fern is now called *Pteridium*. It was also known as Christ's Fern, as it was held that the letters J and C were visible when the rhizome was cut across, while in more recent and prosaic times the arrangement of fibro-vascular bundles has been said to resemble a horse shoe, and the transverse section of the rhizome is said to resemble the outline of an oak tree.

Many of the old writers have dealt with the loss of grazing due to bracken, and have urged the destruction of the weed. The following references are of interest :—

"The war to destroy this so common and known an annoyance, is to Mow it off in the Spring, whether with an Iron or a Wooden Sythe, it matters not, for it will easily break; which work reiterate the same year as fast as it grows, and it is confidently affirmed, that it will kill and destroy the *Fern* for ever after."

J. Worlidge, Systema Agriculturae, 1697.

"I have seen the Roots of it in some Grounds, eight Foot deep. The best cure is often mowing of it while in Grass. If you plow it up, plentiful dunging of it and Ashes are very good: but the certainest cure for it is Urine."

J. Mortimer, The Whole Art of Husbandry, 2nd Ed., 1708.

"*Fern* is undoubtedly one of the worst of Weeds, and hard to be destroyed, where it hath anything of a deep Soil to root in, its Roots extending sometimes eight Foot deep. The best Remedy is often mowing whilst in Grass, *i.e.*, for several Years twice a Year in *May* and in *August*. And when the Land is plowed up, *Lime*, *Marle*, *Ashes* or Rags strewed well over it will perfect the Cure. . . . Some have said that much treading of the Ground with a double Quantity of Cattle is an infallible Way to kill them: But this I dare not answer for."

John Laurence, A New System of Agriculture and Gardening, 1726.

"Mr. Ray, speaking of the fern, says, it is killed by cutting it two years together.

"The destruction and killing of fern by cutting it seems to me to depend on the judicious time of doing it, viz., at the three proper seasons, the spring, Midsummer, and Michaelmas, when and just after the respective buds are shot forth. . . ."

Ed. Lisle, Observations in Husbandry, 1757.

> " Get down with thy brakes, ere 'an showers do come,
> That cattle the better, may pasture have some :
> In June and in August, as well doth appear,
> Is best to mow brakes of all times of the year."
>
> *Tusser*, Hundred Points of Good Husbandry (Mavor's Ed., 1812).

> " In Chatsworth Park, Fern was destroyed, and a good Herbage produced in its place, by a dressing of 260 bushels of Lime per acre, on Shale Grit. In Bradby Park, Fern on a loamy soil is destroyed by mowing twice in the Summer repeatedly, and rolling afterwards with a heavy roller, which produced a kind and good herbage."
>
> *John Farey*, General View of the Agriculture of Derbyshire : Old Board of Agric. Survey, 1813.

Geological History. The genus *Pteridium*, formerly known as *Pteris*, is found in coal and must have been quite common in Carboniferous times, if not earlier. Bracken (*Pteridium aquilinum*) is regarded by some authorities as a close relation of certain of the fossil types, perhaps even descended from them (Scott, Bower). Remains of *Pteridium* are not uncommon in the Bournemouth series (*British Museum Guide to the Fossil Plants*, 1925). It is of interest to note that the flora of the pipe-clay beds of Alum Bay, in the Isle of Wight, which are of about the same age as London Clay, contain leaves of species of *Quercus* (Oak), *Ulmus* (Elm), *Salix* (Willow), *Acer* (Maple) and *Juglans* (Walnut). As this series just precedes the Bournemouth series, the fact noted rather suggests that *Pteridium* followed closely " on the heels " of some of these forest trees.

In the late Miocene age two species of *Pteridium* occurred in the south of England. Later, *Pteris oeningensis* was found, and is considered by some to be the ancestor of our modern *Pteridium aquilinum*. This would place its appearance about the Pliocene age, or approximately the time when the Cromer Forest Beds were formed.

Present Distribution.—*Pteridium aquilinum* is common throughout Europe, and also occurs in many other parts of the world, in both temperate and tropical regions. It is found in both the Northern and Southern Hemispheres, India, Ceylon, near Singapore, Africa, New Zealand, Australia, Tasmania, Canada, the United States, and sparingly in South America.

Bracken ranks as the most plentiful and widespread of British ferns. It is generally distributed in most rough grazings and in many old permanent pastures in almost every part of Britain. It is plentiful in most open woodlands and on the sites of formerly wooded areas, and it is presumed to have been part of the flora of a primitive forest. Bracken is a typical part of the flora of rather open Pedunculate Oak woods or forests, and also appears with the Sessile Oak, and in many other plant associations, including even typical heaths (Tansley, 1911). It does not seem to flourish on calcareous soils or over limestone,

unless the carbonate has been washed out. Excessive soil moisture also restricts its growth and spread, and acid peat adversely affects it. The lime question is interesting, and some success in the control of bracken by applications of lime has been achieved in certain parts of England. Here again, however, the all-important question of cost is the deciding factor. It is said that in former times soil drainage in certain parts of Scotland caused its increase. Unfortunately—so far—there is insufficient evidence to support this statement. In general, bracken is more plentiful and luxuriant in the western counties than in the eastern counties, probably owing to the greater rainfall.

There is also some evidence that alterations in grazing methods and in systems of farming within recent years, have enabled bracken to spread (Ritchie, 1909).

A factor that almost certainly has led to bracken increase is the reduction in cattle, for where there are cattle or other heavy stock grazing and wandering about, they tread down the bracken and seriously injure it. Sheep are too small and too light in the hoof to do this. They invariably avoid bracken unless "struck" by the maggot fly, when they hide themselves, thus causing extra work for the shepherd.

Bracken is more plentiful where arable crops are no longer grown, and where sheep have replaced cattle.

Past Uses. Most weeds at one time had a use or uses and bracken is no exception to this rule. To some extent bracken was used for dyeing. It was also used for thatching, and for this purpose not merely the fronds (leaves) and stalks were used, but also the underground stems or rhizomes; and when there was a considerable amount of thatching it must have taken a heavy toll of the bracken areas. It was also used for litter for both man and beast, and cut regularly for this purpose; this practice continues to a reduced extent. Bracken, cut green and mixed with grass, was at one time used for stock food in the more remote parts of Scotland; and in the green state was used for pigs in England. There is also a record of bracken used as silage, and it is said that stock ate the product with relish, and with no apparent ill effect on their health (Aitken, 1888). This method has apparently never been seriously considered, and several attempts to repeat it have not been successful. It may be that some lucky chance, and just the right conditions and method, led to success. A recent trial led to a remarkably good imitation of farmyard manure (Fenton, 1937).

The use and value of bracken for litter is a matter that requires attention (Berry, 1917; Fenton, 1937, 1938). Over thirty years ago this was investigated by Russell (1908), and

the figures and analyses were very promising. It is being investigated on a small scale at the present time.

Pigs are fond of grubbing up the rhizome of bracken and eat it readily. This fact is utilized by some people for getting rid of bracken, when they turn unringed pigs on to the land. Curiously enough, pigs prefer the rhizome plus soil, and evidently do not like it when the soil has been washed off (Hendrick, 1919). The eating of green bracken by animals—very infrequent—is not a very safe method of feeding, for bracken in a definite sense is slowly poisonous.

Bracken has also been a useful source of potash, and the Department of Agriculture for Scotland has issued a Leaflet (No. 39) on "Bracken as a Source of Potash" (1917). Another old-world use was in the preparation of ash balls, which sold at 3*s*. to 4*s*. per hundred. During the summer the leaves were collected green, dried and then burned and the resulting ash collected. It was then moistened and moulded into balls, which were used in washing; but the cheapness of soda has now killed this local industry.

As far as we are aware, bracken has never been used as a human food in this country, or if so, only very exceptionally. It has been so used in some other countries, *e.g.*, New Zealand, but here it was *Pteris esculenta* (old nomenclature) that was used. The Maoris used the uncooked leaves and the roasted rhizomes, the material known as Aruke. The Japanese are also said to have prepared a meal and a starch from bracken rhizomes. It is further stated that in times of scarcity bracken was used as a food in certain parts of France and in Switzerland.

At one time bracken was used in glass making. The plant contains both gallic and tannic acids. It has astringent properties that partly account for its use medicinally in former times, and it was once used in brewing, serving the purpose that hops have to-day.

Bracken may, however, have a use that has been overlooked or forgotten. It was formerly used for packing cherries and apples, and was said to keep the fruit in excellent condition (Pratt, 1905). Even to-day this use might be considered for similar fruits or vegetables. Perhaps the strangest use for bracken was disclosed in a letter to one of the authors (E. W. F.) two or three years ago. The writer of the letter stated that he boiled up fresh green fronds in an old pot, and the liquid was then syringed over roses attacked by green fly (aphis)—with the result that the liquid completely killed the green fly. Possibly this suggests a new line of inquiry.

The Bracken Plant and its Life History. Bracken is a typical fern of the family Polypodiaceae, and to that group which has marginal *sori*. The part of the plant that appears above ground

is the frond (leaf) and its stalk. The stem (rhizome) is underground, generally grows parallel to the soil surface, and roots come direct from it. The fronds are large, stiff, and generally thrice pinnate. If grown in the open they are a deep green, tough and leathery, with a glossy surface. If growing in shade they are generally lighter in colour and more delicate, not having the tough and leathery texture of those growing in open or exposed conditions. In height the fronds vary from under 1 ft. to 2–3 ft. in poor soil, or up to 10 ft. (occasionally higher) when growing on rich land and lightly shaded by a few trees. The *sori*, bearing the *sporangia* that contain the *spores*, are produced in a continuous line along the margin of the upper segments and summits of the secondary pinnae or "leaflets."

There are generally two systems of rhizome or stem—a deeper layer chiefly for food storage and for growth, from ½–1 in. in diameter; and, nearer the surface, a thinner layer, bearing most of the fronds. The deeper system has lateral branches, but usually only a few fronds. The rhizomes nearer the surface bear numerous petioles and a dense covering of fine roots. Under suitable conditions more than two layers may be found (Braid, 1935). The amount of rhizome may be enormous. Hendrick (1918) reckoned up to 40 tons of rhizome per acre. Similarly, the length of rhizome may be great in spite of the fact that rhizomes die from behind as the apex advances. One plant becomes many by this process of branching.

The rhizome structure is very clearly shown in an illustration in Braid's (1935) paper on "The Eradication of Bracken by Cutting" (Fig. 1). It will be seen that the lower rhizome (Fig. 1A) is much thicker than the upper frond-bearing one. Normally the upper frond-bearing rhizome system (Fig. 1B) arises from the deeper rhizome system (Fig. 1A). Side buds are produced to the right and left of the terminal growing point. This explains why fronds are often found growing in parallel lines. There are also produced dormant buds at the base of the fronds, or near the normal buds. Under very favourable conditions these dormant buds may develop into fronds, or rhizomes that in turn will bear fronds, even when there has been no injury to the fronds or the side buds. This is shown in Fig. 2 (Smith, 1928). This vigorous expansion often provides new growth in ground where the usual rhizome (Fig. 1B) has previously produced fronds. At times there may be several layers of frond-producing rhizomes. When soil conditions are unfavourable (*e.g.*, shallow) all rhizomes may occur seemingly in one layer, so that it becomes difficult to distinguish between A and B (Fig. 1).

The side buds that arise behind the terminal bud give rise each year to fronds (B and C, Fig. 1). There are also, however, the dormant or secondary buds that may develop fronds. Thus

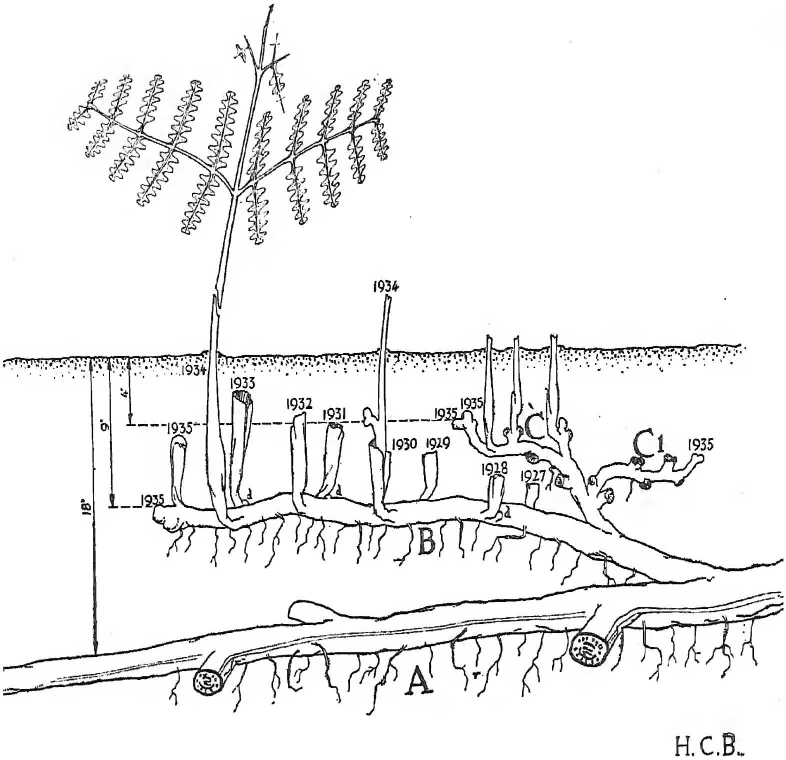

FIG. 1.—BRACKEN: UNDERGROUND SYSTEM IN JANUARY.

A. Main elongating rhizome.
B. Large branch bearing fronds from near apex.
d. Dormant buds. The remains of 1934 fronds extend to surface; those of previous years in various stages of decay. In one case a branch from a dormant bud has grown through an old frond-base.
C. Branch of limited growth; fronds as in B.
C_1. Except at end only leaf-scars are depicted.
r. Roots. (From *Scottish Journal of Agriculture*, April, 1935. By kind permission of the Controller, H.M. Stationery Office).

a bud may give rise to a frond or a rhizome. Again, expecially under the influence of cutting (Fig. 3), (Smith, 1928), double buds may arise, with the result that two fronds may be produced instead of one. Generally, a frond bud is produced at least a year before it appears above ground. Injury to the normal frond for any year may hasten the development of the bud for the following year, so that it appears almost a year ahead of time. It is evident from these bud developments that buds are capable of rapid stimulation, and may grow in a different manner to what is considered normal. This probably explains

why bracken is so difficult to eradicate, for the plant can so readily react to its environment, to abnormal conditions, or to injury.

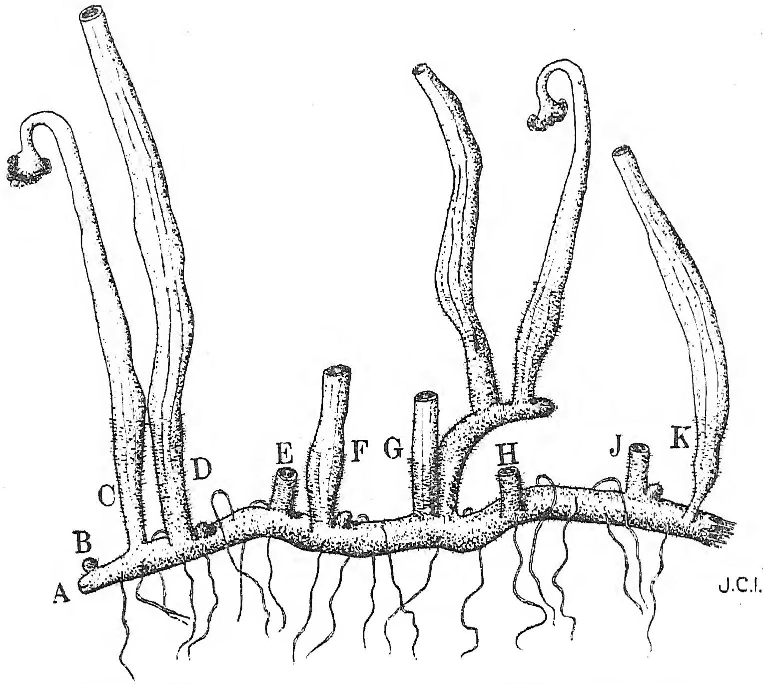

FIG. 2.—TERMINAL PART OF BRACKEN RHIZOME IN MAY, 1928; from a plant cut each year, 1925–1927.

A. Terminal growing-point. B. Frond-lateral growing-point. C. Unfolding frond of 1928. D. Petiole base, 1927, with basal growing-point. E. Base 1927, with basal growing-point. E. Base of a small frond. F. Base of a larger frond with basal growing-point; both E and F probably unfolded in 1926. G. Petiole base, fron 1925; the basal bud has formed a branch with a frond unfolding in 1928. H, J, K. Petiole bases, 1924, 1923 and 1922. (From Transactions and Proceedings of the Botanical Society of Edinburgh. By kind permission of the Society.)

It is obvious from what has been said about the rhizomes that bracken can easily spread, with considerable speed, from a small patch until it covers a huge area. The spread will not be even, as the plant will advance most quickly where soil and other conditions are most favourable. Where it does die out, in course of time, separate areas may continue to spread in all directions and the old initial area may thus be reoccupied. This is the vegetative method of propagation and the chief method of spreading in the drier districts of the eastern parts of Britain.

Besides the vegetative or *asexual* method of propagation there is a *sexual* process. This is rather a complicated method

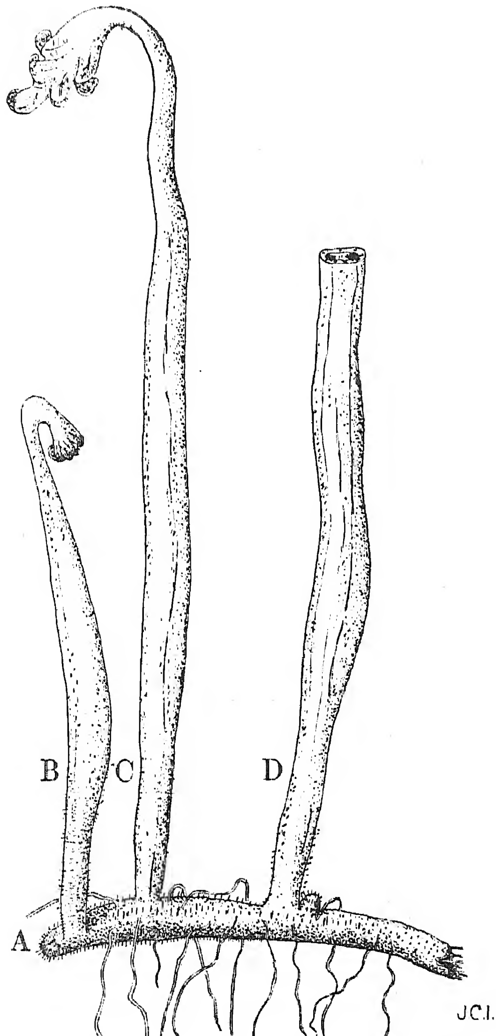

FIG. 3.—APEX OF BRACKEN RHIZOME WITH TWO FRONDS UNFOLDING IN MAY, 1928; from a plant cut each year, 1925–1927.

A. Terminal growing-point. B. and C. Unfolding fronds. D. Petiole base 1927, with basal growing-point. (From Transactions and Proceedings of the Botanical Society of Edinburgh. By kind permission of the Society.)

and most interesting. The ferns, like all plants, are of aquatic origin. Many plants like Liverworts, Mosses and Ferns, retain some of their old ancestral methods, for the parts that are specialized for sexual reproduction are the last to change or become modified. Hence occurs in Ferns what is called alternation of generations—meaning that the child is not like the parent, but like the grandparent.

Unlike ordinary flowering plants, ferns produce not seed but spores, which are very tiny structures that are scattered by air currents. The spores have a very simple structure—much simpler than that of a seed. They consist of a "skin" and within it protoplasm and a nucleus. The spores are, in many ferns, contained within a case called a sporangium (Fig. 4). The sporangium is just a box or case to hold the spores, and to protect them till they are mature and conditions are suitable for their distribution. Some ferns (Fig. 4) have a protective covering for the sporangia, which are produced in masses. This covering is called an *indusium*, and is found on the underside of the frond. In many ferns the indusium is almost umbrella-shaped, and raised from the surface by a short stalk, usually arising from the top of a vein. In the bracken fern the indusium is a continuous fringe along the recurved margin of the frond (Fig. 5). When the sporangium dries, marginal cells in a strong layer (the *annulus*) contract and finally rupture the side, permitting the spores to escape.

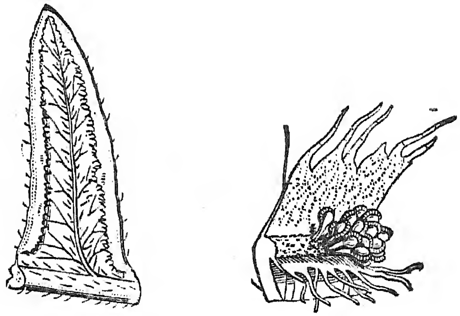

FIG. 5.—PINNÆ OF FRONDS OF FERNS WITH SORI.—*Left:* Bracken. *Right:* The same with the indusium thrown back to show the mode of attachment of the Sporangia. (Reproduced from Watts' "A School Flora," by kind permission of Longmans, Green & Co., Ltd.)

When a spore reaches the ground it will not germinate unless there is a good supply of moisture, and certainly will not survive if subject to desiccation. When a spore does germinate and grow, there develops from it a strange structure called a *prothallus*, which is about the size of one of the old silver threepenny

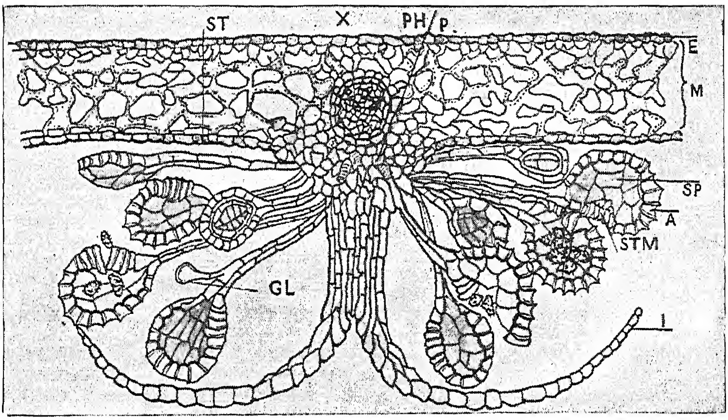

FIG. 4.—TRANSVERSE SECTION OF LEAF OF ASPIDIUM.—*e*, epidermis; *m*, mesophyll; *p*, placenta; *sp*, sporangium; *a*, annulus; *i*, indusium; *st*, stoma; *x*, xylem; *ph*, phloem; *stm*, stomium; *gl*, glandular hair. (From Johnston's Textbook of Botany for Students, by courtesy of Messrs. Allman & Son.)

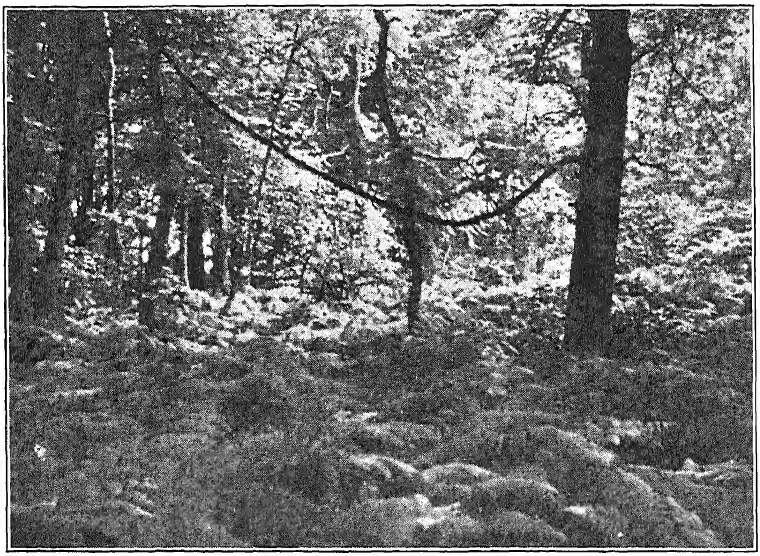

FIG. 6.—BRACKEN ON THE EDGE OF WOODLAND. (Photo, copyright J. G. Long.)

pieces, and almost heart-shaped. It is one cell thick towards the margin and thicker towards the middle, while on the under surface are produced roots or rhizoids and also male and female reproductive organs.

Fertilization cannot succeed unless there is a film of water to enable the "sperms" to swim towards the egg cell and so fertilize it. It will now be realized why moisture is so essential for the success of this stage in the life history of the fern. Here is a very old primitive method of fertilization, not so very far removed from that of many of our common seaweeds. The spore production and spore stage (known as the *sporophyte*) is an adaptation to the land habit, where the plant is surrounded by air, and air must be the medium for distributing the spores. The sexual stage, known as the *gametophyte*, is almost suppressed. It is small and green, and merely exists to secure sexual reproduction when possible. In view of its vegetative reproduction, already described, the bracken fern is a great and complete departure from this primitive prothallus, and a very good adaptation to survival and successful competition with other plants that have also adopted the land habit.

Along the eastern seaboard of Britain the prothallus stage or generation of bracken is difficult to find. Even some distance inland this is also true. On the western side of Britain prothalli, or young bracken plants arising from the fertilized egg cell, are by no means rare. Although several egg cells may be fertilized, generally only one succeeds in producing a fern plant, as one of the young plants crushes out the others. The reason for this marked difference between the east and west coasts is the degree of moisture or rainfall. In higher reaches and areas of heavy rainfall, prothalli may be found, but in the dry regions it is difficult to find even one, except after very long and careful search. Even then, probably only in some moist and very sheltered spot, where desiccation is not likely to occur, may a prothallus be found; this was pointed out by Farrow (1925).

Hence, in the eastern parts of Britain bracken spreads almost entirely by vegetative means (rhizomes), whereas in the moister western areas spread from rhizome growth is supplemented by young ferns arising from prothalli. In moist areas, therefore, bracken can easily commence growth in quite a new centre a considerable distance from that where the spores were produced. In drier areas it is almost entirely, according to present knowledge, a question of spreading out vegetatively from old areas already covered with bracken. This explains the much more rapid spread in the western parts of Britain, especially in the extensive rough and hill grazings of Scotland and Wales. In some parts of the west of Scotland the increase in density and

the rate of spread of bracken have been almost incredible within even the last twenty-five years.

The Spread of Bracken. As previously explained, bracken is a typical plant of rather open oak woodland. It is also found with pine and birch, and occurs frequently along the outer edges of woodlands (Fig. 6). It may appear to some that the spread of bracken is worse in Scotland than in England (Franks, 1935) or Wales (Stapledon, 1936). This is largely true because such a large proportion of Scotland is grouped under rough hill grazings. Naturally it is exceedingly difficult, and often impossible, to control such a pest when the infested area is miles from any headquarters, often even without a road of any kind except a rough track. Another point of importance is that several decades ago most of Scotland's forests and woods were destroyed and much of that land today is used for grazing. In England there is much more of the original wooded areas, so that bracken has not been quite so evident. In England, however, bracken growth is generally much more luxuriant and rapid, and extends over a longer period annually.

In Scotland the spread of bracken became serious after the removal of cattle from the hills and the "clearances" of the crofters. This was followed by the sheep age, which still continues. Neither England nor Wales has suffered to the same extent, but there has been a great spread of bracken in both countries. This is largely bound up with the diminished proportion of agricultural land that is under the plough. As plough land decreases, grass land increases, and land under grass receives less attention. This in turn has led to reduced control of bracken. Unfortunately in no part of Britain is there any practical use for bracken, except that a very little is cut for thatch or litter. At present, then, the plant is a costly nuisance with no redeeming feature.

Again, there is no doubt that the spread of bracken was favoured during the period of the Great War. During the years 1914–18 farmers depended upon skeleton staffs, and only the older gamekeepers and ghillies were available to try to control those great spaces where Nature is ever ready to rebel and have her own way. In most places bracken could not be controlled and huge areas were lost for grazing. The effect of this neglect has been long lasting and today the country is still suffering from this unfortunate period when Nature ran riot. The greater the hold bracken obtains the more difficult it is to control. Many men seem to have lost heart in trying to stem the slow glacier-like movement of the plant as it steadily but surely invades and overwhelms the land. Thus, within the last decade, not only have wide grazing areas suffered but whole crofts have been lost, smothered under bracken (Braid, 1936, 1937). From

the better soil of old crofts, or other once-cultivated fields, bracken is better able to invade less favourable areas. Hence it is that, in many parts, bracken is referred to as "the crofters' successor."

Bracken in Competition with Other Plants. In nature there is always competition between plants for survival. Bracken is subject to this competition, but with the passing of the forests and the shrinkage of arable land, the area where there is little adequate competition is now tending to increase. Dense or fairly dense top canopy of woodland keeps bracken in check and tends to suppress it. As the woodland opens out the bracken becomes stronger, denser, and spreads wherever possible. In woods of such trees as larch or birch, which generally permit ample light to reach the ground, bracken usually shows a strong growth, while it occurs naturally in open oak woods. It may also be found with Scots pine, and can grow with ash where there is only slight shading, but it cannot succeed beneath the denser shade of beech.

In young forest plantations bracken is often a great nuisance and a serious menace to young trees. Its presence generally entails costly cutting and clearing, and there is great danger from fire during the time that the bracken fronds are dead and lying in heaps on the ground. Once trees reach a certain height, and the upper canopy thickens, bracken is doomed and gradually disappears, except in any open space or at the edge of the plantation. An interesting point is that bracken tends to be suppressed wherever there is a good growth of hazel. It is noticeable in several parts of England where hazel occurs that bracken is not nearly so evident. In the past many districts had a dense growth of hazel, as the remains in many peat deposits show. It seems likely that, with the passing of the hazel phase (following the passing of the oak forests), bracken was able to gain a predominant position over many parts of Britain. This is often seen in the wide hedge-banks of many parts of England even today. There bracken is often plentiful, but it stops where the plough reigns.

In grassland or hill grazings where the plough is seldom if ever used, bracken too often finds an area easy to occupy. With the dead fronds lying on the ground the growth of other plants is impossible, while the shade cast by the strong fronds of bracken often makes it impossible for even grass to grow. As long as there is a good cover of heather (*Calluna vulgaris*) or blaeberry (*Vaccinium Myrtillus*) bracken can often be held in check, but after burning, unless the recovery of the previous vegetation is fairly rapid, bracken may get on top, and shade and smother out both these plants. Continuous burning (especially if it is unskilful) and the pressure of sheep grazing, weaken heather,

so that it is steadily giving way to a grassy type of vegetation, Such vegetation offers no competition to bracken, and extensive occupation of the land by bracken is merely a matter of time. Further, when there is a cover of peat, or a heathy mat of undecayed vegetation, burning may severely injure all growth except that which lies six inches or more below the surface. This may mean that only the rhizomes of bracken escape damage. The result is that bracken is left to colonize the bare ground. In East Anglia, as Farrow (1928) has pointed out, bracken can suppress gorse (*Ulex europaeus*), but Fenton (1935) found that in the Spey Valley both gorse and broom (*Cytisus scoparius*) compete very successfully with bracken. Naturally the two areas are very different as regards rainfall, climate and soil.

While this question of competition is under consideration, there is still one more problem that has not yet been answered. Every type or association has within it the " seeds " of its own decay. After bracken has gained the dominant position in any place how long will it continue to flourish there, and—more important—what will succeed it? This question (Fenton, 1936) is a very fascinating and important one. Will birch, or rowan (*Pyrus aucuparia*), or both finally displace bracken if it is left undisturbed? If so, it might be possible to replace bracken gradually, and bring the land back into cultivation, or forestry, as may be deemed most economic. This very important question demands close consideration.

There are certain conditions, besides that of shade, under which bracken finds it difficult to compete with other plants. It makes a poor show on alkaline soil or soil rich in lime. It cannot make much progress, if any, in very wet soil—hence the old cry that drainage schemes lead to the increase of bracken. But drainage is in no sense the main cause of the increase. It might, in places, be possible to flood certain areas temporarily till the bracken was " drowned."

Pests of Bracken.—Almost every plant is attacked at one time or another by insect or fugoid pests, and occasionally there may be diseases or parasites that do not come under either of these headings. Pests at times do serve a useful purpose by helping to check any undue increase of any particular plant or animal. Nature is full of checks to preserve its balance, and as soon as any plant or animal tends to show a spectacular increase some other plant or animal attacks it, and numbers tend to return to normal.

It is a curious and rather important fact, then, that, so far, no pests have appeared to cause any serious check to the abnormal increase of bracken in Britain. Some ten years ago, indeed, a fungus was found attacking bracken, particularly in the West of Scotland. This was thoroughly investigated by Alcock and

Braid (1928) and repeated efforts were made to utilize the fungus as a means of control, but no success was achieved. Further work was done by Barnett (1931). Later Gregor (1932, 1935) investigated several fungus diseases, but no measure of success was obtained except where the bracken was under the shade of trees. Professor Braid also returned to the attack (1934) but with no better result. It is a strange fact that, even where bracken dies out, as in the centre of an old patch, (Braid, 1936) there is rarely any evidence of disease. The primary trouble in such cases may be the lack of potash, or excess of water (Braid, 1936).

With regard to the insect side of disease the position is the same. Cameron (1930) investigated certain Diptera (flies) found attacking bracken, but once again the damage was not sufficient to put any real check on the plant.

It is idle to speculate on what the future may hold in store. So far Nature has not struck, and hence man is left with a difficult problem.

Bracken and Climate.—Not only individual plants, but all the various types of vegetation are affected by climate. Within recent times there has been no drastic change in the climate of Britain, but even since the last ice age there have been two very "genial" periods which produced forests that virtually covered the country. The passing of the second of these forest periods marks, without doubt, the beginning of the bracken phase. For some time past there have been frequent statements that our climate has been changing, but the difficulty has been the lack of figures or records to substantiate these assertions. The truth of these assertions seems, however, to have been verified recently by Lewis (1937). From careful records kept over a century it appears that, in general, our winters have been getting somewhat milder and our summers somewhat cooler during roughly the last fifty years.

This change in climate, though not great, is definite, and we may well ask "What is the significance of this change for bracken?" In the first place surface vegetation, being no longer covered for long periods with snow, is more exposed to frost, cold winds, and heavy rain lashed by high winds. These conditions are unfavourable to surface vegetation, and in places tend to lead to slight erosion of the soil. The change may account for the undoubted erosion and wastage of peat, with loss of the surface covering of heather, on many parts of our west coast. The lack of snow cover, and more continuous exposure to frost, will tend to prevent natural regeneration of heather and other shrubby plants. The cooler summers may have the tendency to make the setting of seed more difficult, so that regeneration from seed is affected. The change would tend to

favour the grassy type of vegetation, which offers a relatively easy conquest to bracken.

A more important point, however, is how this climatic change may affect the normal life of bracken (Braid, 1937). The underground rhizome of bracken is immune from the effects of a normal frost, although a very severe and protracted frost may affect it if the rhizome is at a shallow depth. The exceptional frost of 1917 is a possible explanation of the practical extinction of bracken on the Island of Foula in that year. It is rare, however, for frost to penetrate to the depth at which bracken rhizomes ordinarily lie. Young bracken fronds are readily affected by frost, and quite a fair amount of damage to bracken foliage occurred in the hard spring frosts of 1936. With the heaps of dead fronds and stalks lying on the surface of the ground it is, however, almost impossible for frost to affect severely all the underground rhizomes. Milder winters also tend to give a longer growth period and possibly a slightly earlier appearance in spring. Cooler summers will discourage the main competitors of bracken but will favour the establishment of bracken by spores; cool summers and mild winters certainly favour the germination of these spores, and help the prothalli to produce young ferns. Hence it is evident that the climatic changes which Lewis seems to have demonstrated would be very much in favour of the bracken fern, and may have been a very important factor in assisting its spread.

Bracken Poisoning. The question of bracken poisoning has always presented great difficulties. It must be admitted that proved cases are not frequent, and there are some who strongly deny that bracken poisoning occurs at all, and who maintain that the supposed cases are due to some other plant or plants. Stockman's work, however, may be regarded as conclusive, and bracken poisoning is accepted as a fact in several other countries. From the information available, cattle and horses are the most susceptible species, but they seldom eat bracken unless driven to do so by extreme hunger, or when they receive it as a constituent of inferior hay. A summary of information available is given by Long (1938) in Bulletin No. 57 of the Ministry of Agriculture.

Annual Loss Due to Bracken. Without a very careful survey of the extent of the bracken-infested areas, of their typical vegetation and their normal value, it is quite impossible to give an accurate estimate of the losses caused, which are not entirely agricultural. Foresters are well aware of the costliness of controlling bracken in young plantations. In woods that are rather open it is a nuisance, while in dry weather the risk of fire may be very serious. In many parts of England there is a very rank growth of bracken by roadsides and hedge-rows.

The weed covers over ditches and later, when it dies down, tends to choke the channels. But the greatest loss is occasioned by the smothering of herbage plants in pastures and hill grazings.

Control and Eradication. It has already been hinted that the control of bracken is a very difficult matter. The problem is one that must be faced with the determination that the labours of the years shall restore the grazings that the bracken has stolen.

The attack on bracken may be conducted from several angles—arable cultivations; treatment with lime and fertilizers; grazing with cattle as well as sheep; various methods of cutting and crushing; spraying with certain toxic substances; afforestation with a close-canopy-producing species of conifers, or with beech; or by such combination of these methods as may best suit the local conditions of soil, climate and situation.

Control of bracken is especially difficult in the more remote grazing areas. Accessibility affects not merely transport but the methods to be employed. It is obvious that a given method may be successful in one place but either unsuccessful or economically impracticable elsewhere. The deciding factor is the economic one of costs. In the dry eastern area of Scotland, where growth is generally least rank, Home (1930) has estimated that the cost of cutting an acre by scythe will vary from 2*s*. 6*d*. to 3*s*. 9*d*. In the west, where there is more moisture, and where growth tends to be heavy, the figure will usually be higher. The question is whether the return from the increased grazing area will be sufficient to repay, over a reasonably short period, the cost of cutting.

It is essential that the economic aspect of the problem should be appreciated. It must also, however, be borne in mind that if steps are not taken the farmer must probably look forward to a progressively diminishing area of useful grazing. It may, for instance, be argued that a given piece of land is not worth a rent of 2*s*. 6*d*. per acre and that it must be uneconomic to spend 2*s*. 6*d*. or more cutting bracken; on the other hand if the bracken is not controlled, the ground may become quite worthless.

As bracken is definitely a plant of acid soils, and does not occur on calcareous soils, applications of lime are likely to lead to an early reduction of the weed, and to prove a specific control.

In trials conducted in the west of England, Wallace and Ling found that, while bracken flourishes on acid soils, it appears that in that district normal dressings of lime to bracken-covered areas "will in no way reduce the height or density of the bracken even after a period of nine years." Their recommended treatment consisted in cutting twice in the first two years (June and August), once (July) in each of the

next two years, and thereafter as necessary. Concurrently, a dressing of 10 cwt. of basic slag should be applied in September of the first year, the land being well stocked in autumn until winter; heavy stocking should follow the next summer, and should continue after cutting; in the fifth year a further dressing of 5 cwt. basic slag should be given in September.

As regards cutting or mechanical destruction, this was quite generally carried out, fifty years ago, by means of the scythe, by a stout wire switch attached to a strong stick, or by chain harrows. The ordinary mowing machine was also used where possible. In more recent years various types of bracken-cutting and crushing machines have been devised, many of which are mentioned below. These machines are all more or less effective according to circumstances, and the choice will usually depend upon local conditions, and upon the relative cost of the machines. The speed of the machines is, however, often a matter of more importance than is realized, for the work must be done within a period of two or three months. It is desirable that the cost, per cut, should not exceed 1*s.* 6*d.* to 2*s.* 6*d.* per acre, and the bigger the area cut per day the lower is the cost likely to be. Braid (1938) has shown that either a machine costing £100 or one costing £10 can do the cutting at as little as 1*s.* 6*d.* per acre if it be fully employed, but that the cost may easily amount to 2*s.* 6*d.* per acre or more for a small acreage. It is well to bear in mind that the most effective time for cutting bracken is when the foliage is well grown, *i.e.*, some time in June or July according to district. One or two further cuttings may usefully be done in order to reduce the strength of the rhizomes still further, and to prevent fresh storage of food for the following year's growth.

The use of lime and fertilizers (especially phosphates) should accompany cutting or crushing, and if possible the land should be stocked with cattle, in addition to sheep. It is also regarded as useful practice to give a dressing of 3 to 5 cwt. of agricultural salt, or, better still, if it is practicable, to spray the bracken with a solution of salt. Spraying will directly injure the bracken and make the grazing more attractive to stock.

Spraying with weed killers, whether by ordinary machine or from the air, also has possibilities; both methods have been successful. Solutions of sodium chlorate and of sulphuric acid have been proved to be capable of destroying bracken, but the present position is that the cost is generally much too high to be economic, especially on hill grazings where water is difficult of access. A one-per-cent. solution of sodium chlorate (8 lb. in 80 gallons of water) has proved effective for killing the foliage in summer, and might well be used in lowland areas where the

cost could more easily be borne; the same may be said of a 5 per cent. solution of sulphuric acid (5 gallons acid to 95 gallons water) applied in July and again in early August.

Bates (1937) has described a mechanical method of applying a poisonous solution (sodium chlorate or sodium arsenite) by means of an absorbent pad of sponge rubber, to the cut surface of bracken; he claims considerable success, and that the " method offers possibilities at an economic cost."

The following machines have been "approved" by the Ministry of Agriculture for use in connection with bracken-cutting demonstrations financed by the Ministry and carried out by County Agricultural Organizers :—

- "Collins" Bracken Cutter (Motor).
- "Glaslyn" Bracken Cutter (Horse-drawn).
- "Holt" Bracken Breaker (Horse-drawn).

The following machines have been "approved" by the Department of Agriculture for Scotland for the purposes of the 1938 scheme, under which grants are made to farmers and landlords for the purchase or hire of bracken-cutting machinery :

Motor-driven Machines.

- "Allen" Self-propelled Motor-Scythe.
- "Collins" Standard Bracken Cutter.
- "Collins" One-Wheel Bracken Cutter.
- "Gordon" Bracken and Thistle Cutter and Grass Topping Machine.
- "Irving" Bracken and Thistle Cutting Machine.

Horse-drawn Machines.

- "Glaslyn" Standard Bracken Cutter.
- "Glaslyn Junior" Bracken Cutter.
- "Henderson" Bracken Cutter.
- "Holt" Bracken Breaker.

Other machines, not included in the above lists, are :—

- The "Aitkenhead" Bracken Eradication Attachment (for use with Aitkenhead ripper harrows).
- The "Atcoscythe" (one-wheel machine).
- The "Crossley" Bracken and Thistle Cutter.
- The "Denny" Bracken Scythe (two-swing, cutting both to right and left, covering 10 ft.).
- "Lloyd's Autoscythe" (single wheel mower).

Finally, in the light of present knowledge it seems probable that a combination of methods will prove best: cutting, liming, use of fertilizers (especially phosphates), close grazing with cattle and sheep, and possibly the spraying of selected areas.

In closing this paper, however, the writers desire very definitely to record their view that the bracken menace has grown

so rapidly, and has now attained such proportions, that it is of real national importance: at the International Grassland Congress of 1937 one speaker referred to it as "the ghost stalking silently at our side, which nobody dares to discuss." The position may become overwhelming for agriculture within the next 50 or 100 years. The writers, therefore, urge upon the Government, in the interest of national food production, the necessity for insistent official action and assistance towards bracken destruction and control. A million pounds sterling devoted to reduction of the area infested by bracken would be well spent.

The writers are much indebted to those who have kindly lent illustrations for this paper.

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E. Wyllie Fenton.

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THE STARLING: FRIEND OR ENEMY?

There are certain birds which, without a shadow of doubt, are friends or enemies to farming; nobody disputes the harmfulness of the house-sparrow or the woodpigeon, and no sensible person will dispute the usefulness of the barn owl. But there are other birds whose usefulness or harmfulness is a matter of dispute; among these is the starling, which is so plentiful that its influence on farming may be considerable, for good or for ill. Some naturalists have praised it as a bird useful to the farmer and others have denounced it as a pest. The scales are weighted against the starling, in popular estimation, by matters that have nothing to do with farming; nobody likes starlings very much—they are common birds with raucous voices, they have enormous appetites, they are ungainly and they smell. The naturalist has another ground of complaint against them; they compete, usually successfully, with other more picturesque (and possibly more useful) birds, for nesting holes; several observers have seen them displace woodpeckers from holes that they have made, and swifts and rock-doves are also victimised. From the purely agricultural point of view, however, none of this would matter, provided that the starling could show a balance of good done, by eating insect pests, over evil done by destroying crops, or possibly by carrying disease. The question in dispute is on which side the balance lies: the present paper is intended to throw some light on this, by describing what is at present known about those aspects of the starling's life and habits which are or may be of importance to farming.

Description and Life-history.

The starling (*Sturnus vulgaris vulgaris*) is too familiar a bird to need much description. Its size (8½ inches long) shape, and straight flight, its speckled plumage with purple and green iridescence, and its abilities as a mimic, are well known to nearly everybody, especially since it is a bold bird, and one that frequents human habitations. It occurs in every part of the British Isles, and is common in most places. The nest is almost invariably built in a hole which may be in the roof of a building, in a tree, in thick ivy, or in a haystack; in the treeless Outer Hebrides starlings nest in stone walls or caves in the cliffs. The eggs are pale blue, and usually five to seven in number; there is most often a single brood, starting in April, but two broods are sometimes raised, and starlings have occasionally been known to nest in mid-winter and to bring off a brood in January. (All the nests which the author has been watching in 1938 have had single

broods only.) When the young are fledged they leave the nest, and begin to gather together in flocks; at this stage they are easily distinguishable from their parents, as their plumage is dull brown all over, except for a lighter throat; at one time the young was thought to be a different bird—" the solitary thrush." The flocks move about the country in late summer and autumn, and gradually join together and grow in numbers by the addition of parent birds and immigrants. The flocks roost in company, and by the advent of winter some of these roosts have gathered enormous numbers of birds—though not so many as is commonly supposed; the numbers at a roost often run into many thousands, but certainly not into millions.

The great winter roosts of starlings have been very fully described by Marples (Ref. 1). The birds roost on buildings in towns (St. Paul's Cathedral and Trafalgar Square both harbour large numbers), and in woods (usually of evergreen trees), shrubberies and reed-beds. A really big roost may contain tens of thousands of birds, whose arrival is a most impressive sight. The regular evolutions which the arriving flocks perform, a thousand birds moving together as if at a word of command, have aroused the attention of naturalists from Pliny onwards. In the winter of 1932–33 a survey of all the large roosts in Great Britain was carried out under Marples' supervision; 285 roosts, each of 500 birds or over, were found; these were distributed all over the country, but were nearly all below the 600 ft. contour.

The great majority of starlings pass the winter in these flocks, dispersing when the breeding season begins. Some roosts, however, are occupied all the year round, or only in summer, and it seems that there are always many adult starlings which are not breeding in a given year. Birds from one of these summer roosts were shot and were found to be mostly males; some of these were not in breeding condition, and it may be that large numbers of starlings do not breed until they are two years old. The starling's well-known habit of laying eggs at random, so that they are found broken on the ground, has been supposed to be caused by failure to find a nesting-site, and hence may be evidence that some starlings are not effectively breeding. I have one first-hand observation which supports this theory; on a railway journey from London to Yorkshire on April 14th of this year, when the starling's breeding season was well begun, I observed seven flocks of twenty starlings each, one of thirty, one of forty, and one of between fifty and sixty starlings feeding in a pasture field. The last of these, at any rate, seemed to me to be too big to be made up of nesting birds which had collected together to feed.

The normal length of life of a starling is not accurately known; but in the marking records there are several cases of wild starlings

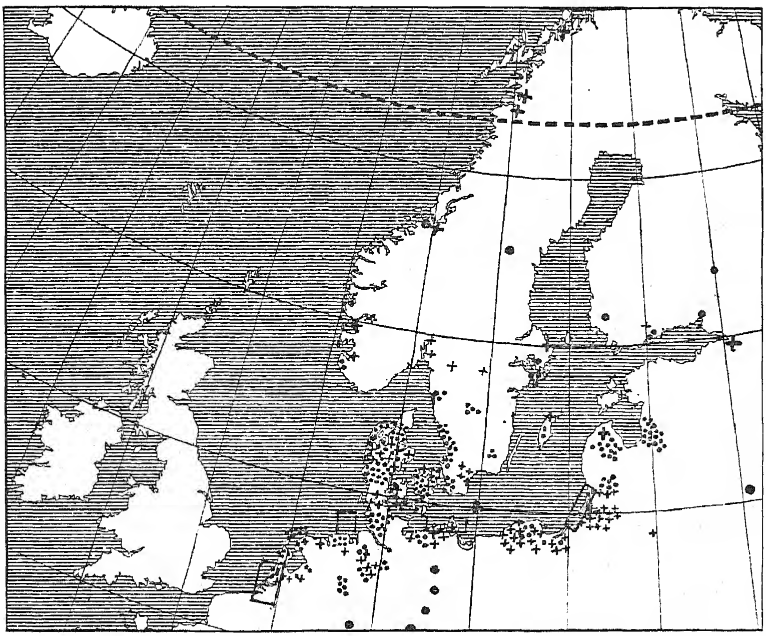
being recovered five and six years after being marked, and one case of recovery after nine years is known; the starling's normal life-span would thus seem to be something over five years. The commoner causes of death are not known, but it may be mentioned that starlings are eaten by birds of prey—tawny owls, peregrines, kestrels and sparrowhawks are all known to feed on them—and also that, in very cold winters, starlings are picked up dead in large numbers. Whether disease and parasites kill many starlings is unknown; Bolam (Ref. 2) mentions an apparent epidemic of undetermined nature, in parts of Cumberland, which killed young starlings in the nest.

Migrations. (See Map.)

As a result of nearly thirty years of work done under the *British Birds* marking scheme (now carried on by the British Trust

MAP TO SHOW ORIGIN OF STARLINGS VISITING BRITISH ISLANDS IN WINTER.

(*Compiled from records of ringed birds by Miss E. P. Leach.*)



Small dots (many birds) large dots (single birds) show localities where birds afterwards reported in winter in all parts of British Islands were ringed in the breeding-season. Crosses show recovery positions in breeding-season of birds ringed in winter in Great Britain. Rectangles show areas where starlings caught on migration were proved by rings to be winter visitors to British Islands.

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for Ornithology), the migrations of the starling are now as well known as those of any bird. In the course of this work over 40,000 starlings were caught, and a numbered aluminium ring placed on one leg; about four rings in every hundred were eventually recovered from birds trapped alive or found dead. The earlier results of this work were analysed by Landsborough Thomson (Ref. 3), and the later by Witherby and Leach (Ref. 4). The conclusions reached are, in outline, as follows:—

(1) The starlings found in Great Britain at different times of year can be divided into two classes: native birds and immigrants. The *native birds* are those hatched in this country; of these a certain number have been shown to be sedentary, passing their whole life within a few miles of the place where they were bred. Other native starlings are migratory within the British Isles, the main movement being a flight southwards and westwards in the autumn, with a return in the spring. For instance, a starling ringed as a nestling in the Midlands was recovered in Somerset the following winter, another was hatched in Essex and wintered in Carmarthen, and a third, hatched in Scotland, was found in Ireland in the winter. Only one ringed starling of native origin has ever been found abroad, a bird hatched in Kent in 1908; this apparently crossed the Channel by the shortest route, as it was found near Boulogne later in the same year.

(2) The *immigrant starlings* are hatched abroad, arrive in this country in the autumn, pass the winter here, and leave again in the following spring. The evidence for their movements is twofold: starlings ringed abroad as nestlings have been found in this country in the winter, and starlings ringed in this country in the winter have been found abroad in the breeding season. The countries of origin of these starlings (which are of the same species as our native birds) are Holland, South Germany, Poland, Norway and the countries round the Baltic Sea—Denmark, North Germany, Lithuania, Latvia, Russia, Finland and South Sweden. There is no relation between the particular place that a bird comes from and that to which it goes; a starling from Holland may be found in Essex or in Wales, while a starling from Russia, hundreds of miles farther east, may fly even farther west and be found in Ireland. No ringed starling of foreign origin has ever been found in the British Isles during the breeding season; apparently they all leave this country in the spring to breed abroad, and our native breeding stock is not augmented by immigrants which remain here. In addition to the main and regular migratory movements there are known to be others, often on a considerable scale, which are due to weather changes; for instance, a week of hard winter weather will emphasize the

south-westerly migration, and will bring starlings to the sea-coast in unusually large numbers.

Is the Starling increasing in Numbers?

One of the most frequently repeated statements about the starling is that it is increasing in numbers year by year. This statement was undoubtedly true in 1870, and may have been true in 1900, or in 1915; but is it still true in 1938? It is often repeated as a fact in popular articles, but it may be doubted whether the writers always look at the dates of the works from which they quote. The one undoubted fact upon which all such statements are based is this: there was, between 1840 and 1890, a most sensational increase in the number of starlings breeding in Great Britain. The evidence is abundant and convincing. Harvie-Brown (Ref. 5), writing in 1895, described in detail the gradual invasion, by starlings, of places in the mainland of Scotland where they had not been seen within living memory, or had been so rare that the finding of a nest was an event to be reported in newspapers. This invasion began shortly after 1840; a farmer at Inverurie, who found a starling in his yard in 1844, did not know what the strange bird was. It was completed in the Lowlands by the late '70's, though the invasion did not reach parts of the Highlands till about 1890. A description of the increase in England is given by Newton (Ref. 6); it is rather pathetic that Bewick (who died in 1828) always wanted a starling to nest on his house, and that his wish was never gratified. In Devon and Cornwall the starling was known only as a winter visitor till about 1885, when it began to breed there. The one part of the British Isles that was unaffected by this change was the extreme north; in the Outer Hebrides, Northern Caithness, the Orkneys and the Shetlands the starling (or its sub-species *Sturnus v. zetlandicus*) has bred from time immemorial, without obvious increase or decrease.

On the other hand, there is no certain evidence that the number of *immigrant* starlings increased during this period, for great winter flocks seem to have been seen throughout the nineteenth century. There may have been an increase, but there is no sufficient proof.

As to the causes of the increase of native birds, the middle of the nineteenth century saw two great changes in the country-side, either or both of which may have been to the advantage of the starling; not only were the middle years of the century the time of greatest development of improved methods of farming, but they were also the time of that wholesale destruction of birds of prey which followed the coming of large-scale game preserving.

In the early years of the nineteenth century, the native starling was a comparatively rare bird; but whether it was always so, or whether its numbers had once been higher, seems to be unknown. The history of the starling before 1800 is quite obscure—naturally, because interest in small birds is a modern phenomenon. The only light which can be thrown on the question comes from two Acts of Parliament passed in Queen Elizabeth's reign, which authorised churchwardens to offer rewards for the killing of noxious animals and birds. Starlings are included in the list, a penny for twelve heads being offered for them, whereas bullfinches were a penny a head. This fact suggests that the starling was common in the sixteenth century.*

It is very difficult, for two reasons, to say how long the nineteenth-century increase in the number of native birds lasted, and whether or not it is still going on. The first reason is that, once a bird increases in numbers sufficiently to be reckoned as "common," it is impossible without making actual counts to be certain whether its numbers are still going up. This has never been done with the native starling (nor, indeed, with any bird till quite recently), as the counting of small and common birds is a very difficult undertaking. The early stages in the increase of a bird population—when a species appears in places where it has not been seen for years—are easy to detect; it is the later stages which are so difficult to follow. The second reason is the confusion, as between summer and winter distribution of the starling, that exists in some accounts written in the early part of the present century, *i.e.*, before its migration had been fully investigated. When these migrations are taken into account, it is clear that the summer population is composed of native birds only, whereas that of winter is a mixture of native and immigrant birds; moreover, the south-westerly movement in autumn is bound to shift the balance of the population in this direction. It follows that observations made in winter, or at unstated seasons of the year, have no bearing on the question of increase in the native starling population, and a good deal of the evidence available is of this kind. For instance, the presence of a large winter roost near Fishguard may have no relation to the abundance of the starling in West Wales during the breeding season.

What evidence there is rather suggests that the increase in the number of starlings has ceased, and that it probably came to an end in the early years of the twentieth century. This is admittedly no more than a guess, but it has the following basis:—In the first place, the writers of the Bird Reports in those volumes

* A rather lurid light is thrown on Elizabethan sanitary conditions by these Acts, which offer rewards for ravens and kites only if killed more than two miles from a town.

of the Victoria County History that were written between 1900 and 1905 all recorded the starling as " an abundant resident " at that time, and some of them evidently regarded it as too plentiful. Further, in his very comprehensive paper on starling roosts, written in 1934, Marples (Ref. 1) gives an estimate of the position as follows: " At the present time they (the starlings) are residents in all districts. . . . They do not appear to be increasing now as they were twenty or thirty years ago, and of twenty estimates of change which I have received, twelve report a decrease in numbers." Finally, the starling is still a rare and local bird, during summer, in Western Ireland; in the extreme west of Wales it was said, ten years ago, not to breed except in a few places, and this seems to be still the case; at all events, a report from a sizable village near Cardigan says that there were no starlings' nests at all there this year, and my informant does not remember ever having found a nest in that district, although starlings are seen in winter. This would seem to show that the westward advance of the starling, as a breeding species, has, at least for the present, come to an end.

But is the starling increasing or decreasing in numbers at the present time? This is a question which it is impossible to answer without a great deal more knowledge than we have. Even if the increase in the native population has come to a stop, it is possible that the number of immigrant birds is going up. Separate knowledge is needed of the winter and of the summer population, and this knowledge must have a numerical basis. The starling may be said to be a common bird everywhere in England, but the word " common " may mean five birds to the square mile in one place and five hundred in another. In the case of the winter population, a possible numerical basis is the census of roosts carried out by Marples (Ref. 1) in the winter of 1932–33. A new census might answer the question as far as the winter population is concerned. But there is no such numerical estimate of the summer population, and a new means of counting starlings must be devised before anything more than guesses can be made about this.

Experimental Count of Starlings' Nests.

In May 1938 a preliminary attempt was made to find a means of counting starlings. The results cannot be said to answer any questions about the summer distribution, but at least they illustrate the difficulties encountered in attempting such a count, and suggest a way by which a satisfactory technique of counting might be evolved. As a beginning, it was thought advisable to try to count nests rather than birds, although (as has been pointed out) nesting birds probably do not make up the whole of the summer population. Starlings' nests are comparatively easy to find, for the parent birds are bold enough to enter and

leave their nesting-holes in full view of the observer, and the whereabouts of a nest may also be given away by the white stains of droppings or, when the young birds are hatched, by their noisy squeaking. In order to obtain counts in widely separated districts, schools in various parts of England were asked to co-operate in counting nests, and there was a very satisfactory response to this request. Several schools undertook a count with enthusiasm, and carried it out carefully. The first method tried was to count all the nests in a known area of country, and in Table I are given the results, arranged in order of the size of area covered.

Table I.

Count of Starlings' Nests in a known Area.

Place.	Count done by	Nature of area.	Size.	Number of nests.	Acres per Nest.	Nests per sq. mile.
		A.—*Over* 100 *acres.*				
1. Burford, Oxon.	Burford Grammar School.	Open country with farms and hamlets.	25 sq.miles	1,148	13·9	46
2. Halsham, E. Yorks.	Withernsea Central School.	Two farms	2 sq.miles	28	45·7	14
3. Bramwith, nr. Doncaster.	Norton School ..	Mixed farming country, 4 small villages.	1 sq.mile	85	7·5	85
4. Ottringham, E. Yorks.	Withernsea Central School.	Farm	400 acres	16	25	26
5. Holt, Norfolk	Gresham's School N.H. Society.	Fields and woods, some houses.	320 acres	21	15·2	42
6. Harpenden, Herts.	J. Meiklejohn ..	House and grounds, home farm, woods.	310 acres	41	7·6	85
7. Ottringham, E. Yorks.	Withernsea Central School.	Farm	160 acres	5	32	20
8. Bakewell, Derby	Lady Manners School.	Wooded farm	130 acres	16	8·1	79
		B.—*Under* 100 *acres.*				
9. Owstwick, E. Yorks.	Withernsea Central School.	Farm	40 acres	12	3·3	192
10. Highfield, Durham.	Mr. Errington ..	Colliery village	40 acres	54	0·74	864
11. Ryehill, Yorks	Withernsea Central School.	Village and farm	40 acres	31	1·3	496
12. Newland, Hull	Sailors' Orphan Home.	Buildings and grounds.	30 acres	42	0·71	896
13. Newcastle, Staffs.	Mr. Taylor ..	School grounds	10 acres	4	2·5	256

It will be seen that counts in open country show a concentration of from 14 to 85 nests to the square mile, or a space of from 7½ to 46 acres for each nest. But the counts in the second half of the table show that much higher concentrations can be found over small areas, especially if these areas are built up. (Compare, for example, count 11 with count 2.) In the case of

count 12, where a very high concentration is recorded, the area is described as "an oasis in a rapidly growing district." The sender of the report adds: "The tall chimneys which top the houses fairly ask to be used as nesting places." In this particular count the highest number of nests in one building was eight, found in a house which had been left empty for some weeks—starlings are nothing if not opportunists.

In some of the area surveys notes were made of the number of nests in different situations, and the results are given in Table II.

TABLE II.

Situation of Nests.

Survey.	Nests in buildings.	Nests in trees.	Other sites.	Total.
1. Withernsea Central School ..	54	12	11 in stacks	77
2. Norton School	83	1	1 in wall	85
3. Lady Manners School, Bakewell	5	11	——	16
4. Gresham's School, Holt	9	11	1 in hedge*	21
5. Harpenden survey	21	20	——	41

This table illustrates, not so much the preference of starlings for particular sites, as the opportunities which the locality affords; the last three surveys in this list include woods, and hence have a higher proportion of nests in trees. The entry marked with a star shows a very unusual site for a starling's nest, but there is no doubt of its accuracy.

When the experimental counts were begun, it was thought probable that the great majority of starlings nested in towns and villages. A trial was therefore made of a method of counting which might give the relative numbers of nests in different towns. For this purpose the nests in one or in several streets were counted, and the number of nests was related to the length of the street and the total number of houses. But this method does not give a reliable estimate of the number of starlings in a district, for reasons that will appear. In these street counts the starling's opportunism in the matter of nesting-sites was very well illustrated, but one constant observation was that new houses had no nests built on them. In the survey made at Staindrop one large house, with plenty of outbuildings and an orchard, had no less than 40 nests about it. (These are not included in the table.) As a rough method of estimating the feeding ground available to each nest, it was assumed that the birds would fly up to 220 yards for food (about the distance they have actually been observed to fly), and hence 22 yards of street length was taken to represent one acre—but this is, of course, only an approximation. The results are given in Table III, in which the localities have been arranged from north to south.

Table III.

Street Counts of Starlings' Nests.

Place.	Count done by	Street length (yds.).	Total No. of houses.	Number of nests.	Nests per 100 houses.	Yards per nest.	Acres per nest (approx.).
1. Staindrop, Durham ..	Staindrop C.E. School	2,640	198	270	136	9·8	0·44
2. Withernsea, E. Yorks ..	Withernsea Central School	3,520	36	46	127	76·5	3·5
(b) " " ..	"	150	—	2	—	75	3·4
(c) " " ..	"	229	—	24	—	9·5	0·43
(d) " " ..	"	440	—	21	—	21	0·95
(e) " " ..	"	170	—	19	—	8·9	0·4
(f) Patrington, E. Yorks ..	"	385	—	9	—	42·8	1·95
(g) Roos, E. Yorks ..	"	880	20	38	190	23·2	1·05
3. Norton, nr. Doncaster ..	Norton School	3,520	160	116	73	30·3	1·38
4. Bakewell, Derbyshire ..	Lady Manners School	275	28	15	54	18·3	0·83
(b) Eyam, Derbyshire ..	"	440	22	9	40	49	2·23
(c) " " ..	"	200	16	11	69	18·2	0·83
(d) Stanton-in-Peak ..	"	170	12	11	90	15·5	0·7
(e) Stoney Middleton ..	"	400	62 (22 new)	3	5	133	6·0
5. Fakenham, Norfolk ..	Fakenham Secondary School	1,951	328	106	32	18·4	0·84
(b) Wells-on-Sea, Norfolk	"	4,360	286	41	14	106·3	4·83
(c) Sheringham, Norfolk ..	"	4,704	398	72	18	65·3	2·97
(d) Little Walsingham ..	"	1,046	102	60	59	17·4	0·79
(e) Holt, Norfolk	"	1,622	301	51	17	31·8	1·45
(f) Burnham Market ..	"	5,618	301	48	16	117	5·32
6. Harpenden, Herts ..	J. Meiklejohn	300	23	5	22	60	2·73

It will be seen, on comparing Tables I and III, that the local concentration of starlings' nests is higher in towns and villages than in the open country. Counts made in adjoining areas illustrate this. For instance, at Holt, Norfolk, the street count shows a density about ten times as great as the field count, and the two counts made by the Withernsea School show the same kind of difference. Unfortunately, owing to the great local variation, a count made in a village cannot be used as an index of the population in the surrounding district. This is illustrated very clearly in the series of counts carried out by Fakenham Secondary School; one can see no obvious reason why starlings' nests should be more abundant at Little Walsingham than at Holt, yet this was plainly the fact. The differences in density of nests, as between different places in the Fakenham survey, seem to be real, as in the detailed results (which are too long to publish in full) the numbers are given street by street, and the figures for "yards per nest" and "nests per 100 houses" are nearly constant for each town. It is possible that the town counts are an index of the abundance of nesting-sites rather than of the abundance of starlings.

The results obtained from these counts can be summed up as follows :—

(1) The density of starlings' nests is much greater in built-up areas than in open country.

(2) In open country there appear to be from 14 to 85 nests (28 to 170 breeding birds) to the square mile. This figure is lower than those given by other authors for the density of starlings in winter; the latter are from one to three birds an acre, or from 640 to 1,920 birds to the square mile.

(3) The method of counting starlings in towns, though easy to carry out, is unsatisfactory, because the variations within districts are so large that they hide any possible variations between districts, and also because nesting-sites rather than birds may be counted.

(4) The method adopted for Table I, of counting nests in a given area, is promising. If surveys of this kind could be arranged in a sufficient number of areas, of adequate size, a reliable estimate of the relative number of starlings in different districts could be obtained. Such a survey would be very laborious, and the difficulty of dealing with built-up areas would have to be overcome; but it seems to offer the only practicable method of making even a relative count of the number of starlings in summer.

The Food of the Starling.

The most important characteristic of any bird, from the farmer's point of view, is undoubtedly its diet—the kinds of food that it eats, and the amount of each kind. In the case of the starling's diet a great deal of information has been collected, mostly by the examination of the stomach contents of dead birds. This method naturally gives more reliable results than can be obtained by watching the birds, as any bird seen at a distance may actually be eating something quite different from its apparent food. An example of this is given by Florence (Ref. 7), who was sent 13 starlings shot in May "in the act of eating grain"; she found that one bird had taken a few grains, but that the stomachs of it and its fellows contained 91 caterpillars, 65 leather-jackets, 30 wireworms, 74 click-beetles, 34 dung-beetles, and 30 weevils—all injurious insects.

Taking together the results obtained from the examination of stomach contents by different authors a very complete list is obtained of the kinds of food that starlings eat; but difficulties arise when the results are compared in order to find out how much of each kind of food is eaten. As Ritchie (Ref. 8) has pointed out, the main difficulty in work of this kind is that of obtaining a fair sample of the whole bird population; results

obtained at one particular season should not be interpreted to cover the whole year, nor should results obtained in one district be supposed to hold good for the whole country.

But when these difficulties are allowed for there is, on the whole, good agreement between different authors as to the nature of the starling's food. In the first place, the starling's diet, especially in the spring, includes a great variety of insects. Large numbers of insects are collected for the nestlings, which live almost entirely on animal food; but insects are taken the whole year round, even in winter. The insects eaten include a number of harmful kinds. Click-beetles and their grubs (wire-worms), leather-jackets, cutworms (surface-feeding caterpillars), cockchafer grubs, earwigs, pea-and-bean weevils, and turnip flea-beetles, are all regular items of the starling's diet. Naturally the starling cannot be expected to choose the harmful insect every time, and harmless or useful insects are also eaten; but Theobald and McGowan (Ref. 9), who examined 748 starling stomachs, found 5,908 insects of harmful kinds, and only 1,552 useful ones. Slugs, snails and millipedes are other harmful creatures which are regularly eaten, and starlings have also been found (but not often) to take woodlice, freshwater shrimps, and crabs and shrimps from the seashore.

In addition to animal food, however, the starling eats a good deal of vegetable material, including grain; some of the grain found in starlings' stomachs may be scattered grain picked up from rickyards or roads, but Hammond (Ref. 10) showed that in Cambridgeshire newly-sown wheat was eaten by starlings, especially in November and December; on the other hand, neither spring-sown wheat nor oats nor barley was much affected. The sprouting winter wheat was pulled up, seed and all, and the seed eaten, the blade being left. Theobald and McGowan (Ref. 9) examined the amount of grain in each month of the year, and confirmed that starlings eat newly-sown grain, especially in winter, but that they do not eat corn in the ear; they found that very little is taken between April and September, which finding agrees with Hammond's results. Another vegetable item in the starling's diet is fruit; wild fruits seem to form part of its natural food, as Hammond found that large quantities of elder-berries were eaten in September, and also blackberries. Rowan berries were found by Florence (Ref. 7), and two American workers, Kalmbach and Gabrielson (Ref. 11), found that, in New England, nearly a quarter of the food was made up of a variety of wild fruits. Unfortunately for the fruit grower, however, starlings will eat cultivated fruit if available; apples, plums and strawberries have all been recorded, and Kalmbach and Gabrielson, and also Collinge (Ref. 12), say that starlings are especially fond of cherries. Weed seeds are sometimes eaten, and a variety of

animal and vegetable foods from rubbish-heaps, as well as bread and other things put out for birds.

The food habits of the starling therefore make it both a useful and a harmful bird to farming; useful because of the large number of noxious insects it eats, and harmful in arable districts because it eats winter-sown grain, and in fruit-growing districts because of its fondness for cherries. But it is difficult, on the available evidence, to say whether it does more good than harm. Those observers whose results are based on the greatest number of observations, Theobald and McGowan, (Ref. 9) find that the balance is in favour of the starling. The most comprehensive and most recent study (that of Kalmbach and Gabrielson), which is based on the examination of nearly 2,500 birds, also finds that the starling does more good than harm; but their results refer to the United States, and can hardly be applied to England.

Has the Starling changed its Food Habits?

A charge which is frequently repeated against the starling is that its food habits have changed, or are changing progressively, and for the worse as far as farming is concerned; the contention is that, year by year, starlings eat fewer insects and more grain and fruit. The published evidence on which this view is based is contained in the work of Collinge (Ref. 12), who examined 368 stomachs of adult starlings between 1911 and 1918, and found a higher proportion of vegetable food, especially fruit, than had been reported in previous enquiries. Now the earliest investigations on the starling's food are those of Gilmour (Ref. 13) in 1896; his birds were collected in Fife, and mostly in the winter, which circumstances would of course minimise the amount of fruit found. Other early investigations were those of Florence and Hammond, who also examined birds collected under circumstances where little fruit would be available; Hammond's birds were not collected in a fruit-growing district, and Florence received no starlings for examination between the end of June and the beginning of November. It is doubtful whether Collinge's results can be compared directly with others collected in such different places and under such different circumstances.

In any case, and whatever may be thought of the possibility of a past change in the starling's food, there is no evidence on the question whether its food habits are changing now. The interest in the food of birds that was manifested twenty years ago seems to have died down; at all events, no investigation on these lines has been carried out in this country since 1918. To base a theory of progressive change on observations that are twenty years old, without knowing what has happened in the interval, would, unless and until a new set of actual observations on the starling's

food are made, leave it unknown whether or not any change is taking place at the present time.

Starlings and Foot-and-Mouth Disease.

The most serious indictment that is brought against the starling is that it is the carrier of foot-and-mouth disease into this country. This is a very widely held belief, and, to judge by correspondence in the Press, many people regard it as definitely proved.*

Now there is a good deal of circumstantial evidence that the disease may be brought into this country from abroad by *birds*. When an outbreak occurs for the first time in autumn and in the Eastern Counties, as was the case with the serious outbreak which began in Norfolk about October 16th, 1937, it coincides both in place and in time with the autumn migration of birds across the North Sea, and the infection may quite possibly have been carried from the Continent by a bird. This view is put forward in a memorandum in the Journal of the Ministry of Agriculture for January 1938 (Ref. 14), but the writer states the case against birds in general, and does not name any particular bird. The fact is that birds of a number of different species besides the starling make regular east-to-west crossings of the southern North Sea in autumn. Among these are rooks, crows and jackdaws, skylarks, linnets, chaffinches, lapwings, and possibly pigeons and gulls. Any of these birds may have brought infection over, not by catching the disease themselves (birds are, as far as is known, not susceptible to foot-and-mouth disease), but mechanically on their feet, beaks, or feathers.

But in the popular imagination the starling is the villain of the piece, and no other bird is held responsible. There are probably two grounds for this belief, one reasonable and one unreasonable. The reasonable one is that starlings consort more than other birds with cattle and sheep; they feed in pastures where animals are grazing, and they sit on feeding troughs (but so do many other birds, including rooks and woodpigeons). The unreasonable cause is the widespread dislike of the starling that exists it is so much easier to believe that starlings are disease-carriers than that skylarks might be.

Of course birds are not the only things that cross from the Continent in autumn; the infection might have been brought on the car-tyres of a returning tourist; it would not be possible to prove definitely that the infection was brought by birds unless all other ways of transmission were ruled out. It is impossible to prove that birds never carry the infection, but equally impossible to say definitely (*a*) that foot-and-mouth disease is brought

* See, for instance, *Country Life* for December 1937 and January 1938.

into England by birds, or (*b*) that the starling is the principal transmitter. In any case, as the writer in the Ministry of Agriculture Journal says: "No organized measures against the risk of the introduction of infection by this means (the agency of birds) are considered practicable."

Conclusion.

Although the starling is a very common bird, it seems that in many of its aspects, including those which bear most directly on its importance to agriculture, it is still imperfectly known. We are not even certain whether the starling population of Great Britain is increasing or decreasing at the present time, nor do we know in which districts starlings are most concentrated; and the very abundance of the bird will make it an extremely laborious matter to answer either question. The only aspects of its life on which we have accurate information are those which have interested competent naturalists, such as its migrations and winter roosts. On the charges which are brought against the starling, which bring it under popular suspicion as a harmful bird, we can, in the present state of our knowledge, only bring in a verdict of "Not proven." This is not to say that the charges are untrue; further knowledge may reveal the starling as a pest, but on what we now know we cannot condemn it.

It would be deplorable if, in the present state of our knowledge of the starling, an attempt were made to exterminate it as a pest. If this attempt were even partially successful, farmers in England might live to regret it; for one of the things that are certainly known about the starling is that it eats a large number of harmful insects. With its long powerful beak and its habit of digging in the ground, it is better adapted than most birds to deal with insect pests that live in the soil. If our choice is between certainly harmful wireworms and doubtfully harmful starlings, we should do well to keep the starlings.

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A Note on the effect of removing Leaves upon the subsequent growth of Wheat and Barley.

I was asked to make some observations on the subsequent effect on the plant when its first leaf is bitten off by a bird, and, although this type of damage is more typical of sparrows than of starlings, the results obtained were not without interest, and are given briefly here. Counts of tillers made in the field upon both wheat and barley showed no significant difference in tiller number between plants that had apparently been bitten, and others which had apparently been untouched. Two pot experiments were therefore set up, one with wheat and one with barley, in which the whole of the plant above ground was removed at different stages with the finger and thumb, to imitate the action of a bird's beak. Eight pots were used in each experiment, and

each picking was done in duplicate; the arrangement of the pickings was randomised among the pots. One very striking feature of the experiment was the rapidity with which the plants recovered; after the first pick, when the leaves were about an inch high, all the plants showed visible growth again on the second day. The details of the method were as follows :—

Wheat.	*Days after sowing.*	*Average Height of shoots removed.*	*First signs of recovery.*
1st pick..	18	3·0 cm. (1st leaf)	2 days later
2nd pick	22	7·3 cm.	2 days later
3rd pick	56	15·2 cm.	3 days later
Barley.			
1st pick..	21	5·3 cm. (1st leaf)	2 days later
2nd pick	23	9·1 cm.	5 days later

A tiller count was done on the wheat pots just before the third pick (56 days after sowing), which gave the following number of tillers per plant—*Controls* 1·5; 1*st Pick* 2·07 : 2*nd Pick* 1·38. As the seeds were sown very late the plants did not grow well; they were harvested when nearly a foot high, by cutting off the whole of the plant above ground. The results were as follows :—

Plant.	*Treatment.*	*Average weight per pot (fresh).*	*Number of tillers per plant.*	*Average length of 20 longest shoots.*
Wheat ..	Control ..	13·05 gr.	5·57	27·7 cm.
	1st pick ..	12·04 gr.	5·59	26·8 cm.
	2nd pick ..	10·76 gr.	6·28	26·2 cm.
	3rd pick ..	8·79 gr.	5·94	24·7 cm.
Barley ..	Control ..	7·29 gr.	4·41	27·3 cm.
	1st pick ..	5·86 gr.	4·63	26·4 cm.
	2nd pick ..	5·63 gr.	5·09	22·8 cm.

It will be seen that the removal of the leaves decreased the total weight of the crop and the average shoot height, but slightly increased the number of tillers. The effect became more marked the later the removal was made. After the total removal of the first leaf, both wheat and barley made an almost complete recovery.

K. M.

FARM ORGANIZATION ON THE SILT SOILS OF HOLLAND, LINCOLNSHIRE.

That area of the east of England generally known as "the Fens" covers approximately 800,000 acres, and comprises some of the most fertile farming land of Britain. Although fairly homogeneous in regard to climate and marketing opportunities, the area is not homogeneous in regard to soil, and two major types are evident. To the north, in those portions nearest the sea, the soil is predominantly silt laid down by tidal action, while to the south and west the soil is chiefly peat derived from decayed fresh-water marsh plants (see Diagram 1). Each of these two major soil types has distinctive agricultural characteristics which are responsible for marked differences in the types and qualities of the farm crops produced. Of the total area of "the Fens", somewhere about 450,000 acres consist of silts and 350,000 acres of peats.

In the previous issue of this *Journal* the writers gave some account of farm organization on the peat soils.[1] The present article deals in parallel manner with the silt soils and should be considered as complementary to the former. The reader is asked to refer to the earlier article for certain general information, here omitted to avoid repetition, concerning the whole fen basin.

I.—General Description of the Silt Area.[2]

The silt soils of the fens are fine alluvial deposits varying from a light to a heavy texture according to the percentage of clay. Speaking generally the texture is lightest near the Wash and gets heavier as the distance from the sea increases. The land surface is flat, and there can be few natural eminences higher than 15 feet above Liverpool Datum. Almost the whole area lies below high water mark, and the average height probably approximates 10 feet O.D.

Drainage depends on a complex system of artificial waterways, pumping stations, sea banks, and sluice gates. In spite of this, or rather because of this, the silts are probably the best drained area in the country. They are in a favourable position compared with the peats to the south and west of the fen basin, because the latter, owing to their proneness to "wastage" on cultivation and aeration, have sunk considerably

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[1] Farm Organization on the Black Fens of the Isle of Ely. *Journ. Roy. Agric. Soc. Eng.*, Vol. 98.

[2] For a more detailed and comprehensive account see *Report of the Land Utilisation Survey*, Pt. 69, Lincolnshire (Parts of Holland), 1937; *Agric. Progress, XI*, 1934, Fenland Farming, J. C. Wallace; A Survey of the soils and fruit of the Wisbech area, *Min. of Agric. Research Monograph, No.* 6, 1929.

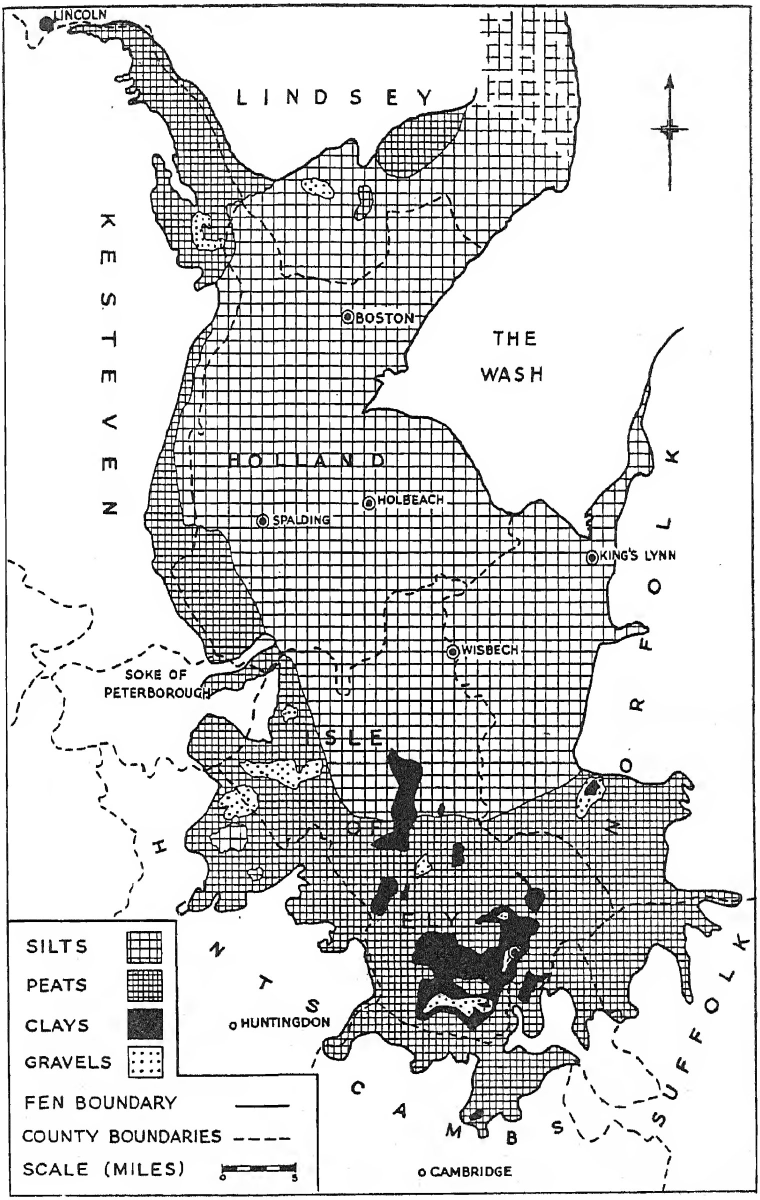

DIAGRAM I.—The Fens.

since their reclamation. Indeed it is important to note that the peats, which before reclamation had a somewhat higher surface level than the silts, are now on the average lower than the silts. Thus a depression is gradually forming between the silts to seaward and the higher ground to landward, and the engineering problem of preventing this depression from reverting to a condition of swamp is becoming ever more acute. It is the peats, not the silts, which would be the first to suffer from any major break-down in the drainage system of the fens.

The rainfall of the area approximates 24 in. per annum, of which some 40 per cent. falls between January and June, and 60 per cent. between July and December. Temperatures are low during the winter months, and late frosts (up till May) frequently do extensive damage. A small area to the north-east of Boston, and lying adjacent to the Wash, is peculiarly exempt from these late spring frosts.

There are no large centres of population within the area, the main towns being Boston (population 16,600), Spalding (12,600), Holbeach (6,100), Wisbech (12,000), and King's Lynn (20,600). In the Holland Division, which consists almost entirely of silt soils, 46 per cent. of the working population was engaged in agricultural occupations according to the 1931 Census, a figure which compares with 6 per cent. for England and Wales as a whole. Thus, the principal industry of the district is agriculture, and the bulk of the farm produce is exported, chiefly to London, Midland, and Northern markets.

The district is served by a network of well-surfaced roads, and in this respect presents a pleasant contrast to the adjacent peat soil area. The rapid development in recent years of motor transport direct from farm to market, so valuable for the perishable goods produced in the district, has been encouraged, perhaps made possible, by these roads. Railway facilities to the north, west, and south are also good, while the ports of King's Lynn and Boston offer a further method of transport. In this latter connection it may be mentioned that there is a considerable export from the silts of seed potatoes to Spain and Morocco, and of various root seeds (turnips, mangolds, etc.) to America and Europe, and much of this produce is shipped direct from these ports.

II.—General Description of Farming on the Silts.

Until the last quarter of the 19th Century the silts were largely devoted to pasture, and were famed throughout Britain for the richness of their grass and the quantity and quality of the stock which they produced. Fruit growing was started on a commercial scale round Wisbech in the latter half of the 19th Century, but even more important was the development

of potato growing in the Boston district after 1880, with which the name of William Dennis is so closely associated. In the closing years of the 19th Century, when arable land was tumbling down to grass in most parts of Britain, the silt pastures, under the stimulus of high cash returns, were rapidly broken up, and today the silts share with the peats the distinction of forming the most predominantly arable area of England, with some 80 per cent. of the farmed land under the plough.[1] Cropping is very intensive, and not only are yields per acre large, but the nature of crops grown is such as to provide high cash returns. Potatoes are the staple crop, but wheat, sugar beet, market garden crops, flowers, various seed crops, fruit, and glass-house produce all figure prominently in the gross incomes of farmers in the area. Cereals are grown for much the same reasons as a fallow shift is found in other districts, that is for rotational purposes. The principal cereal is wheat, but considerable areas of oats are also grown. The oats are frequently not threshed but are chaffed entire for horse feed. Barley is of negligible importance. In the Holland Division, which extends to just over a quarter of a million acres, and with which this article is chiefly concerned, the distribution of the cropping in 1936 was as shown in Table I. (p. 58).

These statistics represent cropping as at 4th June, and must therefore omit considerable acreages of catch crops, such as vegetables after early potatoes, planted and harvested between the census dates. Further they fail to disclose[2] certain special seed crops, such as mangolds, sugar beet, swedes, and turnips, which are grown in the district, and which, covering some 4,000—5,000 acres, are of considerable economic importance. Nevertheless these crude statistics do give some idea of the intensity of the cropping on these soils. The Holland Division, despite its small size, has the distinction of producing a larger acreage of potatoes, seed mustard, root seeds, bulbs, and (excepting Lindsey) of peas for canning and packeting, than any other county in Britain. It is second to none in regard to yields per acre of corn. The bulb industry has developed rapidly since the war and is now an important factor in the rural economy of the district. There are some 4,000 acres of daffodils, narcissi, tulips, and hyacinths in the Holland Division alone (particularly around Spalding), and immense quantities of cut flowers and dry bulbs are produced annually, providing labour for thousands of women and girls. These bulb fields also attract large numbers of sightseers in April and May, and special excursions by train

[1] For a brief description of more recent changes see *Kirton Agricultural Journal*, No. 1, 1938.

[2] In the 4th June Returns no differentiation is made between mangolds, turnips and swedes grown for fodder and grown for seed.

Table I.—Land Distribution of the Holland Division, 1936.

	Acres.
Total Area (excluding water)	266,660
Arable	190,517
Permanent grass	47,707
Rough Grazings	1,145

—	Acres.	Per cent. of arable area.	Per cent. of farmed land.
Cropping:		%	%
Wheat	46,046	24·2	19·2
Oats	16,750	8·8	6·9
Other corn	4,401	2·3	1·8
Peas[1]	11,004	5·7	4·6
Beans	4,755	2·4	2·0
Potatoes[2]	57,909	30·4	24·1
Sugar beet	15,782	8·3	6·5
Mangolds, turnips, swedes, cabbage, kohl rabi, and rape[3]	4,442	2·3	1·8
Temporary grasses, clovers, lucerne, vetches and tares	8,881	4·6	3·7
Small fruit[4]	3,412	1·8	1·4
Orchards[5]	2,260	1·1	0·9
Bare fallow	2,871	1·5	1·2
Other crops[6]	12,558	6·6	5·3
Total Arable	190,517	100·0	79·5

[1] Of this total peas for canning and packeting represent 5,950 acres, and peas picked green for market 2,250 acres.
[2] Of this total 7,900 acres are first earlies.
[3] Includes roots grown for seed, which occupy over 4,000 acres.
[4] Of this total 2,700 acres are under strawberries.
[5] Includes 554 acres underplanted with small fruit already enumerated.
[6] This total comprises mustard for seed 6,200 acres, vegetables (cauliflowers, broccoli, cabbages, brussel sprouts, carrots, onions, etc.) 2,000 acres, flowers (chiefly daffodils, narcissi, and tulips) 4,000 acres.

and 'bus are run from London and other centres during the flower season. Glass-house production (of melons, cucumbers, tomatoes, out-of-season vegetables and flowers) is also assuming considerable importance. In this, " Dutch Lights " and various other adaptations of glass are now widely used.

Permanent pasture, which represents some 20 per cent. of the farmed land, consists to a considerable extent of " washes " and river banks. The washes (*e.g.* Cowbit Wash) are an integral part of the drainage system; they consist of land lying adjacent to a main river on to which surplus water is allowed to over-flow, at flood times, in order to relieve pressure on the out-falls to the sea. Owing to their frequent submersion during the winter months, these lands cannot be cultivated; they are therefore

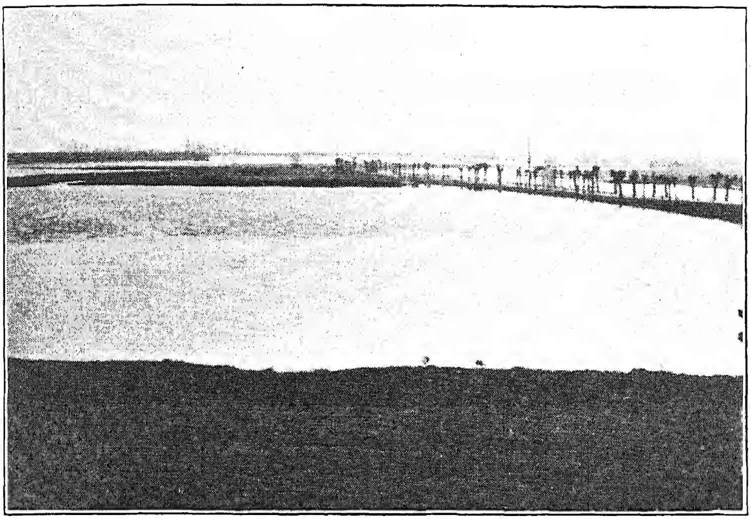

FIG. 1.—A flooded " Wash " in Winter.

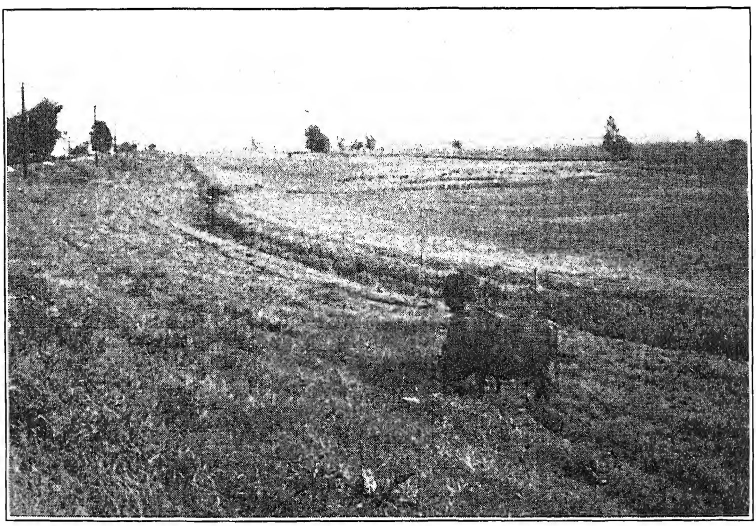

FIG. 2.—Cowbit Wash in Summer.

FIG. 3.—Potatoes—The " Sheet-Anchor " of Holland Farming.

FIG. 4.—Dressing Potatoes—Note canvas wind-break.

cut for hay, or grazed, or both, during the summer months. The banks of the rivers and drains provide considerable areas of coarse grazing and hay, while the marshes along the coast line, on unreclaimed land or on land in the process of reclamation, are also used for grazing during the summer months. Enclosed permanent grass fields are common on the heavier silts found furthest from the sea, but on the lighter soils these seldom exceed the minimum area necessary for turning out the horses, and on many farms amount to no more than a small paddock adjacent to the farm steading. There are many farms on which there is no permanent grass at all.

Livestock is of secondary importance, and is kept largely for making dung and utilising crop by-products. This must not be taken to imply that the livestock output per 100 acres is here necessarily less than that of the country as a whole, but rather that the crop output is abnormally high. Cattle for beef, and pigs, are the principal types of stock; the density of the former being less, and that of the latter greater, than for England and Wales as a whole. The cattle are mainly of the Lincoln Red type; some rearing is done, but dairying is relatively unimportant. Fair numbers of poultry, generally run as a side-line, are to be found, but sheep, except round the sea marshes, are conspicuous by their absence.

Measured in acres, the silt farms are, on the average, even smaller than those on the peats, and considerably smaller than in England and Wales as a whole. Of the total holdings of one acre and upwards in the Holland Division, 54 per cent. are less than 20 acres, while the average size of holdings of 20 acres and upwards is only 93 acres. These figures compare with 43 per cent. of holdings less than 20 acres, and with 135 acres as the average size of holdings of 20 acres and upwards, in England and Wales as a whole. It will be shown later that a considerable proportion of the holdings of less than 20 acres on these silts are not full-time agricultural occupations (see page 63). The larger farms are generally found on the lighter soils adjacent to the sea coast, and on the heavier lands in the south and west. The largest farm in the Holland Division extends to some 5,000 acres, but in 1936 there were only 7 farms over 1,000 acres, while no more than 117 farms, or 3 per cent. of the total holdings, were over 300 acres in size.

Owing primarily to the intensity of the cropping, but perhaps in some measure to the smallness of the farms, the labour density is high. For the Holland Division the number of workers (including casuals) averages about 6½ per 100 acres, or almost exactly double that for England and Wales as a whole. Casual employment is, as may be imagined, an important factor where so many horticultural and other special crops are grown. Indeed,

the period of employment for casual workers begins in April with the potato planting, and extends through a series of operations (early potato lifting, root seed harvests, main potato and sugar beet harvests) till nearly December. The wives and families of the regular employees, together with women from the local villages, supply the greater part of this seasonal work, but there is also a certain amount of immigrant labour from Ireland and other districts.

Where such a diversity of cropping is found it is difficult to define the rotation. As has already been said, potatoes are the staple crop, being taken generally once every three or four years. In the chief "early" locality, to the north-east of Boston,[1] potatoes may be taken every alternate year, and in some cases fields are actually cropped continuously with potatoes over a series of years, with a catch crop for ploughing in green between one season and the next. It is little to be wondered at that eelworm has made its appearance, and it is, perhaps, more a matter for surprise that this pest is not more widespread (see page 68). To minimise the risk of further developments there has been a tendency in recent years for farmers in the district to lengthen their rotations. An approximation of the common cropping plan is (1) Potatoes, (2) Sugar beet, mustard for seed, or roots for seed, (3) Wheat or oats, with (4) Peas, beans, or clover, where the rotation is four course. One of the outstanding differences between the cropping on the silts and that on the peats is the greater importance of potatoes and smaller importance of sugar beet on the former. For example, in the Holland Division, which is mainly silt, the potato acreage is roughly four times as large as the beet acreage, whereas in the Isle of Ely, which is mainly peat, the potato acreage is less than double the beet acreage. The relatively smaller sugar beet area on the silts arises through substitution by root seeds and mustard.

The two most common varieties of maincrop potatoes on the silts are Majestic and King Edward. The King Edward appears to stand a rather stronger soil than the Majestic, and although yielding, perhaps, two tons less per acre, generally fetches £1—£2 more per ton. About half the potato acreage is planted with Scottish seed every year, and nearly all seed is chitted before planting. Practically every farm has its own glass chitting house, and it is becoming increasingly recognised that the process of chitting is improved by allowing the seed adequate access to light and air.[2] The seed is put into the

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[1] See Midland Agric. College *Survey Studies*—3 : Potato Production and Marketing in the East Midlands. 1935.

[2] See Ministry of Agric. Bull. 94.

chitting house in October or November, and is brought on slowly with a view to securing a short, strong, well-coloured shoot before planting the following April or May. Chitting gives a longer growing period to the crop and thus may normally be expected to result in heavier crops. It also reduces the risk of loss from blight and drought. Further, by speeding up the rate of maturing, chitting ordinarily results in better prices for the early varieties. During the summer months the chitting houses are generally used for growing tomatoes, which may in themselves pay the maintenance cost of the house.

Preparation of the land for potatoes involves heavy dunging and ploughing 10-12 inches deep, as well as sub-soiling, particularly on the larger farms. Where potatoes follow clover, the aftermath of the latter is invariably ploughed in. In some cases (although this practice appears to be decreasing) the first cut of clover is allowed to lie on the land and, when the aftermath grows through it, the whole is ploughed in. A crop of beans is sometimes grown and ploughed in as preparation for potatoes. Although this involves the sacrifice of a year's crop it is reckoned that the beneficial effect on the succeeding potato yield provides an adequate recompense. In addition to liberal dressings of dung, fertilisers are generally applied at the rate of about 15 cwt. per acre (see page 71). It is only in exceptional cases that planting is done otherwise than by hand, the fact that most of the seed is chitted restricting the use of planting machines. Tractor row-crop equipment for drawing, splitting and earthing up the ridges is generally to be found only on the largest farms. Of the various pests and diseases, blight appears to be the most troublesome, and although on the larger farms dusting is commonly done, a surprisingly big proportion of the smaller farmers neither spray nor dust (see page 68). In harvesting the crop, particularly where the tubers are to be clamped, ploughing out is preferred to spinning, with a view to avoiding bruising. The bulk of the main crop is clamped in the usual way, and dressing and bagging proceed fairly steadily through the winter, although supplies are apt to come forward too rapidly in January and February when there is little field work in hand. Dressing machines have so far found little favour, as it is not considered possible to get so good a sample as by hand riddling. Quite a feature of the district during the winter months are the wind-breaks of sacking or canvas rigged up beside the potato clamps to protect the dressing gangs from the bitter winds. Wastage in the clamp may occasionally be heavy, but normally will not exceed 10 per cent., and is frequently less. On dressing from the clamp it is commonly reckoned that 25 cwt. of sound potatoes will yield about 20 cwt. ware, 3 cwt. seed, and 2 cwt. chats. In this connection it may be mentioned that considerable

quantities of seed potatoes are sold from the silt soils, and this adds appreciably to the income derived from ware. There is now a market for chat potatoes at Wisbech, where there is a factory for making potato meal.

Considerable areas of both white and brown mustard are grown on contract for manufacture or for seed, and follow potatoes in the rotation. Drilling takes place in late February and early March, at a seed rate of $1\frac{1}{2}$ to 4 lb. per acre. The drills are generally about 18 in. apart, and some growers single the plant in the drill, although most do not. The crop is harvested in August, being cut by hand, tied, dried and carted as with root seeds (see below). Yields may run from 10 to 15 cwt. per acre. The white variety yields rather more heavily than the brown, and is less prone to cause trouble as a weed in the subsequent crops; but the latter fetches a better price per cwt. and on balance probably gives slightly higher cash returns per acre.

Various seed crops are produced of which the more important are swedes, mangolds, turnips, and sugar beet. These are grown at a contract price per cwt., the purchaser supplying parent seed. Such crops generally follow potatoes and receive little or no fertilizers. Seeding takes place in August or early September, turnips being drilled direct in the field, but swedes, mangolds, and sugar beet being first sown in a seed bed from which they are transplanted to the field between November and March. The rows are generally spaced about 27 in. apart with 12 in. between the plants (swedes may be set as close as 20 in. by 6 in.) Transplanting is done on piece rates at about 2*s.* per thousand. One man can set about 5,000 plants per day, so that with 25,000 to the acre, this operation costs about 50*s.* per acre. The rows are hand and horse-hoed, then moulded up and subsequently "rogued." Harvesting takes place in July and August, the stalks being cut by hand while still green, tied in bundles and left till dry, when they are carted and stacked. Great care is necessary to avoid loss through "shelling," the carts being lined with sacking, the stacks built on sheets, and all movements undertaken with caution. Yields of swede and turnip seed commonly range from 10-15 cwt. per acre, and those of mangolds and sugar beet from 15-25 cwt. per acre. The value of the crop may vary from £15 to £35 per acre.

A variety of other unusual and valuable crops might be cited, and, indeed, in this fertile district it is frequently difficult to decide where agriculture ends and horticulture begins. The bulb industry merits a monograph on its own account,[1] but the present article must necessarily exclude much interesting detail.

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[1] See Ministry of Agric. Bull. No. 62.

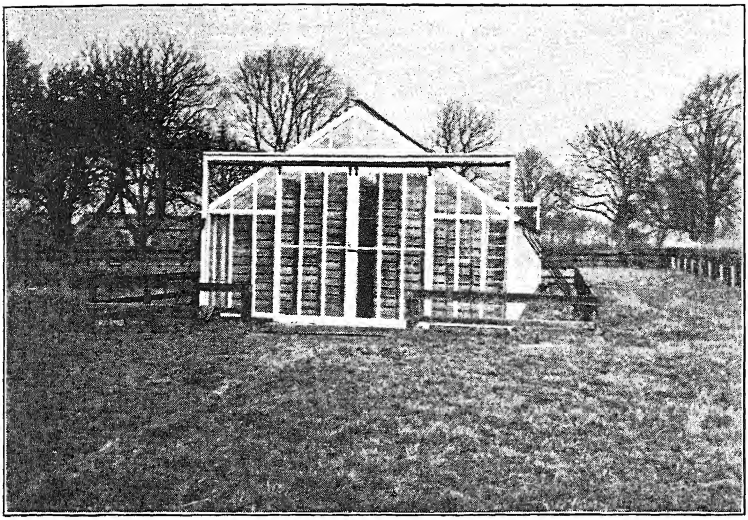

Fig. 5.—Glass Chitting House.

Fig. 6.—Well-kept Ditches.

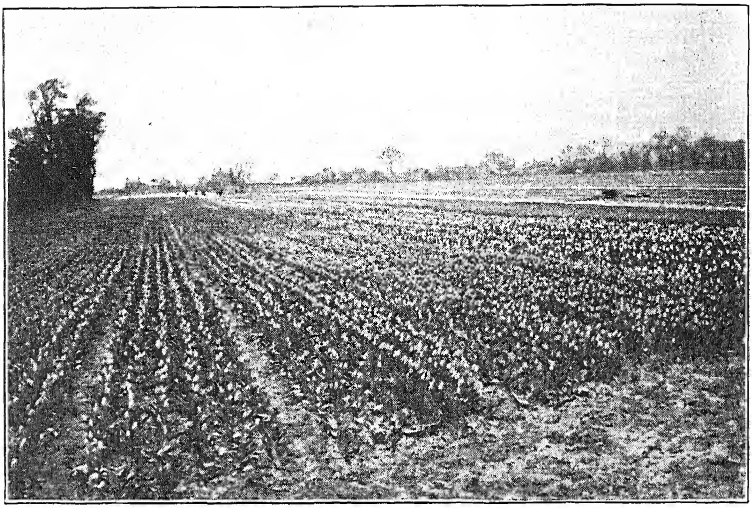

Fig. 7.—Tulip Fields in April.

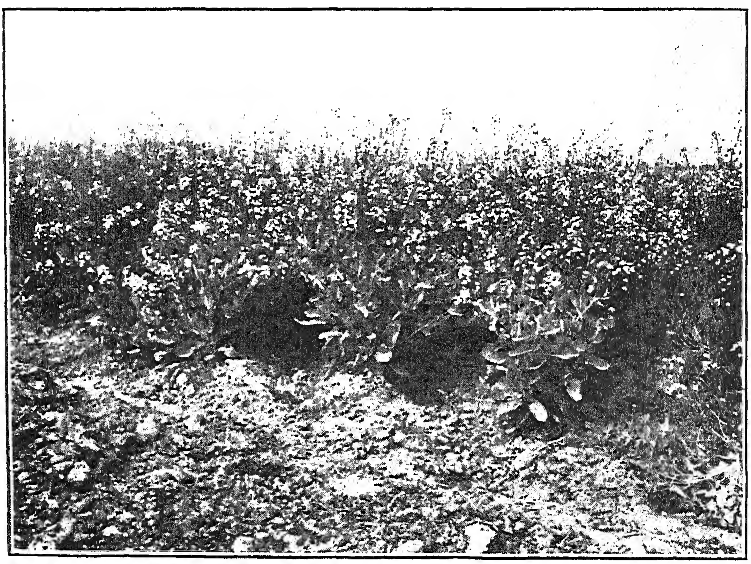

Fig. 8.—Swedes for seed, at flowering stage.

In the following pages the reader will find the results of an economic survey of general farming conditions on a sample area selected within the Holland Division.

III.—A Survey of Farming in Two Parishes.

The adjacent parishes of Whaplode and Moulton were selected as the field of study on the grounds that they lie roughly in the centre of the silt-soil area, that they contain a fair sample of the different types of silt common to the district, and that they do not include any large centre of population nor any specialized bulb or early potato area. These two parishes lie midway between the towns of Spalding and Holbeach and, being long and narrow in shape, and running north and south, roughly bisect the Holland Division. They cover some 22,500 acres, and according to the 4th June returns for 1936 contain 498 holdings of 1 acre and upwards. Of these holdings, 283, or 57 per cent., are less than 20 acres, and 215, or 43 per cent., are 20 acres or more in size. This size distribution is similar to that of Holland as a whole (see page 59).

An attempt was made to identify all the 283 holdings of less than 20 acres in the two selected parishes, but a considerable proportion of these could not be traced. Of the holdings identified roughly half were full-time occupations and half were part-time occupations. The occupiers of the part-time holdings were mainly (two-thirds) agricultural employees on neighbouring farms, while one-third consisted of village tradesmen, artisans, and others whose main income was derived from some non-agricultural occupation.

The principal part of the investigation aimed, however, at securing detailed records of farm organization from holdings of 20 acres and upwards, obtaining as far as possible a random sample. "Composite" farms (*i.e.*, a farm of which the occupier holds another farm or other farms elsewhere) were omitted from the selection on account of certain obvious technical difficulties which arise in recording such holdings. Altogether, detailed records were obtained from 52 out of the 215 farms in the two parishes, but of these only 45 are used in the ensuing analyses. So small a sample cannot, of course, be considered representative of an area the size of Holland, more particularly as the data refer to only one crop season, but it may at least give some idea of the nature of the internal organization of farming in the district. In so far as size distribution is concerned the sample is reasonably representative, for, of the 45 farms for which detailed records are here used, 22 are between 20 and 50 acres in size, 13 between 50 and 100 acres, 5 between 100 and 150 acres, 3 between 150 and 300 acres, and 2 are over 300 acres. The "average" size of the whole 45 farms is 87 acres, and this compares

with a figure of 93 acres as the average size of all holdings over 20 acres in the Holland Division.

The farm records were collected in the early months of 1938, and refer to the crops grown and harvested in 1937. The records were obtained by a process of oral question and answer with each farmer, following the usual survey technique described in various Reports issued by the Cambridge University Farm Economics Branch. In the ensuing pages the data thus secured are compared with similar data for the same crop year referring to certain high-land districts in the Eastern Counties.[1] Where possible comparisons are also made with the results of the survey of peat soil farms in the Isle of Ely reported in the previous volume of this *Journal*, but the difference in time period of the two investigations (the peat soil survey referred to the 1936 crop year) makes certain horizontal comparisons between the peats and the silts unsatisfactory, particularly comparisons of the amount and composition of gross incomes.

Size of Business.

As on the peat soils of the Isle of Ely, the average area of farms on the silts tends to be considerably smaller than on the adjacent uplands. In the Holland Division the average area of holdings of 20 acres and upwards is 93 acres as compared with 135 acres for Norfolk, Suffolk, Cambridgeshire, and Huntingdonshire. Against this, however, must be set the much greater intensity of farming methods on the silts (and peats) where capitalization, employment, and output per 100 acres are each approximately twice as great as on neighbouring upland farms. It is generally appreciated that capital and output are much better measures of the size of a farm business than area, and on these criteria the average size of silt farms is considerably larger than on the uplands.

Diagram II illustrates the amount and distribution of the farm capital per 100 acres on the present sample of silt farms, together with comparable data for certain upland districts in the Eastern Counties. On the silts the Michaelmas valuation of farm livestock, crops, and equipment averages £23¾ per acre as compared with £9½ to £12 in the four other districts. On the silts the major investment is in crops (£15 per acre), livestock coming next at £5¼ per acre, with equipment making up the balance of £3½ per acre. On the upland farms there is generally a close correlation between area of holding and capitalization

[1] The other " type of farming " districts are : (1) mid-Norfolk medium loams; (2) north Essex boulder clays; (3) south Essex London clays; and (4) south Cambridge chalk soils. In the various diagrams each of these districts is represented by 45 farms, and full details will be found in *Report* 26 of the Cambridge University Farm Economics Branch.

per acre—the larger the area the smaller being the capital per acre. But on the silts, as on the peats, the larger farms do not appear to be organized appreciably less intensively than the smaller farms.

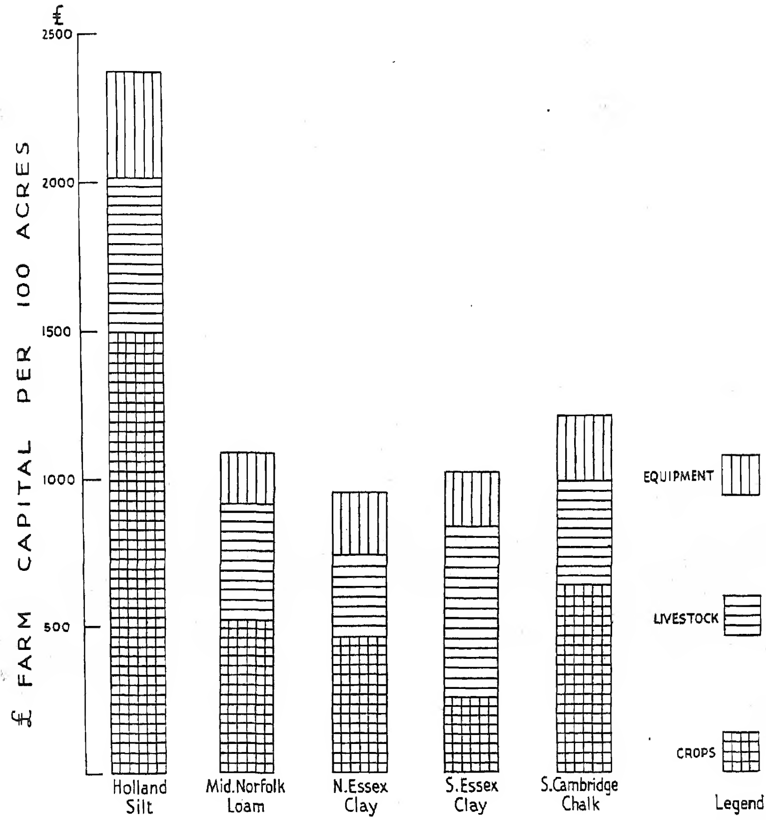

DIAGRAM II.—Comparison of Farm Capitalisation in five districts.

The number of manual workers[1] on the sample of silt farms averages exactly 6 per 100 acres, which compares with a figure of approximately 3 for the other four districts. In regard to work horses the position is similar, the silt farms averaging $4\frac{1}{2}$ per 100 acres as compared with $2\frac{1}{4}$ on the upland farms. On

[1] Casual workmen, women and boys are here included at an appropriate fraction of full-time adult employees. The figure can thus not be compared directly with the official estimates which enumerate *all* persons in employment as at June 4th.

the silts there is roughly one tractor per 180 acres of arable land, which compares with one per 210 acres on the upland farms.

Cropping.

Diagram III illustrates the crop distribution in 1937 on the 45 silt farms covered by the investigation. The proportion of permanent grass on the silt sample, at 28 per cent., is rather higher than normal for Holland as a whole, where permanent grass represents only about 20 per cent. of the farmed area. For the sample, temporary grasses and clover represent only 5 per cent. of the farmed area, and this gives some indication of the unusual nature of the rotations in the district. Potatoes are the principal crop, accounting for one-fifth of the total farmed land and over a quarter of the arable area. It will be observed that the proportion of potatoes on the silts is larger

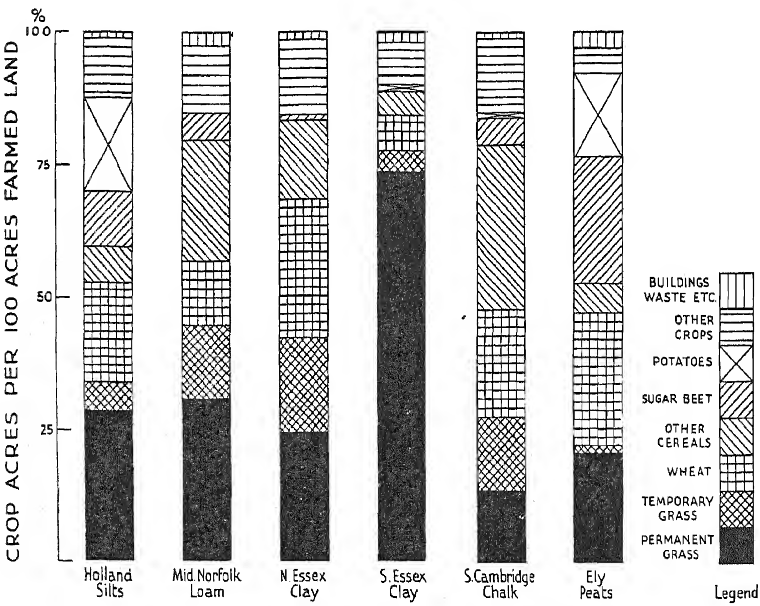

DIAGRAM III.—Comparison of Cropping in six districts.

even than that on the peats, and very much larger than in the other four districts. Wheat is the main straw crop, accounting for one-fifth of the farmed area, while "other cereals" collectively represent only about one-twentieth. The area of sugar beet, at about one-tenth of the farmed land, although considerably greater than in the upland districts, is only half that on

the peats, while the acreage devoted to "other crops" on the silts is double that on the peats. On the silt farms these "other crops" contain a much larger proportion of high-value cash products—root seeds, mustard for seed, peas for packeting or picking green, bulbs, and strawberries—than on the peats. Thus, comparing the cropping on the silts and peats the main differences are that on the former there is (*a*) a somewhat larger acreage of potatoes, (*b*) a considerably smaller acreage of beet, (*c*) a larger acreage of root seed, mustard for seed, and other high-value cash crops, and (*d*) a smaller acreage of wheat.

Considering the silt sample as a whole, roughly three-fifths of the total farmed area, or four-fifths of the arable area, are under cash crops, and these proportions are considerably higher than for upland arable districts generally, where the comparable proportions approximate two-fifths and three-fifths respectively. Not only is the acreage under cash crops relatively large, but, as on the peats, the types of crops grown on the silts are mainly those which yield high money receipts per acre, potatoes alone occupying from a quarter to a third of the arable land. Further, crop yields per acre are exceptionally high on these silt lands. For example, on the sample under investigation the average per acre yields in 1937 were :—wheat and oats 24 cwt.; potatoes 10½ tons; sugar beet 11 tons; and seeds hay 2 tons. These yields are from a third to a half higher than for the country as a whole. As with all other measures of farm production, the range in yield per acre between the individual silt farms was large, wheat varying from 14 cwt. to 31 cwt., potatoes from 5 tons to 15 tons, and sugar beet from 3 tons to 17 tons. The higher figures noted are by no means records for the district.

Potatoes.

As potatoes are so important a factor in the farming of the district the survey included certain special enquiries in regard to this crop. Details of the manuring will be found on page 71, but here a brief reference will be made to varieties, yields, diseases, and treatment. In regard to the varieties grown on the present sample of farms, Majestic accounted for 52 per cent. of the total potato acreage, King Edward for 21 per cent., Doon Star for 13 per cent., Eclipse for 9 per cent., and various other varieties for 5 per cent. The average yields per acre were :— Majestic, 11½ tons; Doon Star, 10 tons; Eclipse, 9½ tons; and King Edward, 9 tons. For all varieties together the average yield worked out at 10½ tons per acre. In this connection it must be noted that estimates of yield represent "disposals," and include seed and "seconds" sold, as well as ware. The Ministry of Agriculture's Statistics give the decennial average yield for Holland as only 7½ tons per acre. This official

estimate includes earlies, of which comparatively few are grown in the two parishes included in the present survey. For the county as a whole the acreage of earlies is roughly one-seventh of the total potato acreage (see Table I), but even allowing for this the official estimate seems surprisingly low, considering that main crop yields of 10–12 tons per acre are common, and that there is a relatively large sale of seed potatoes from the district.

In regard to diseases and pests, a quarter of the growers had no special complaints, but two-thirds specified "blight" and one-tenth specified eelworm as being troublesome. In view of the prevalence of blight it was rather surprising to find that only one-third of the farmers who were visited actually sprayed or dusted. The great number of small farms in the district no doubt partly explains the apparently common omission of spraying, and it seems likely that the acreage which is sprayed is in fact larger than these figures suggest.[1] The most common time for the first spraying was early July, although in a few cases it was done as early as mid-June. Of the farmers who sprayed or dusted the majority were in the habit of making at least two applications.

Nearly one-fifth of the growers had evidence of potato root eel-worm (*Heterodera schachtii*) on their holdings, although this was generally confined to one field or a portion of one field, and in no case was it stated to be serious.

There appeared to be no evidence that the incidence of virus diseases has increased in the last ten years.

Gross Incomes.

The gross income of the 45 silt farms for which records were obtained averaged £18½ per acre of farmed land,[2] or £27½ per acre of arable. These figures are nearly twice as large as in the four other districts. Of the gross income, crops accounted for roughly three-quarters and livestock for one-quarter, so that both the relative and absolute importance of crops is much greater on the silts than in neighbouring upland arable counties. Potatoes are by far the most important single source of income on the silts, accounting for about 40 per cent. of the total.[2]

[1] In the present sample the one-third of growers who commonly sprayed or dusted were responsible for more than half the total potato acreage.

[2] The average price realised for the 1937 potato crop by the present sample of silt farmers approximated £4 per ton, and was therefore considerably less than the prices ruling for the previous year's crop. If the average price had been £5 instead of £4 (total production remaining constant) gross incomes would have been raised by roughly £2 per acre of farmed land. That is a variation of 25 per cent. in *either* yield *or* price of potatoes will alter gross incomes on silt farms by about 10 per cent. (*i.e.*, $25 \times 40 \div 100 = 10$).

The next most important items are sugar beet and wheat, each of which represents about 13 per cent. of the gross income. The relative unimportance of barley on the silts is clearly indicated in the diagram. It will be seen that "other crops" contribute

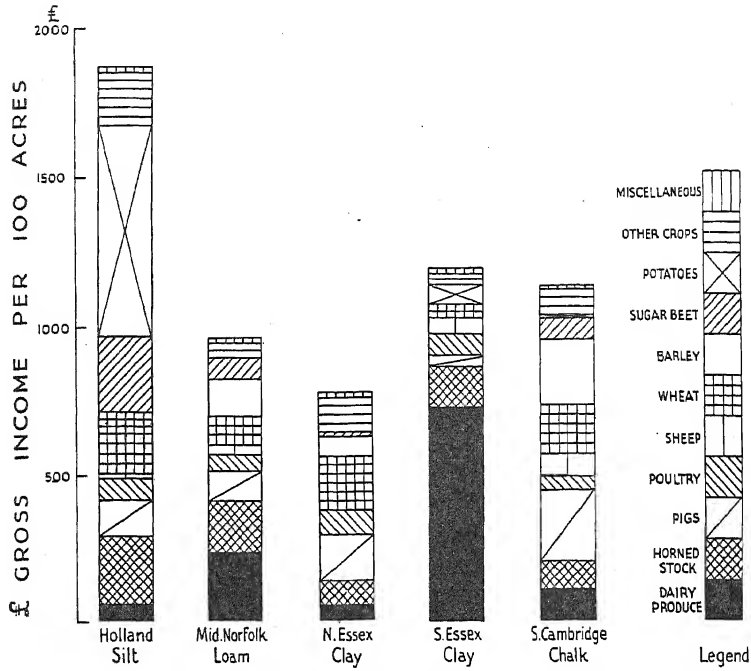

DIAGRAM IV.—Comparison of Gross Farm Incomes in five districts.

very substantially to receipts, amounting to nearly 10 per cent. of total incomes. On the sample under review these "other crops" comprised:

	Per cent.
Turnip, swede, and mangold seed	30
Mustard seed	9
Peas for packeting and green	10
Bulbs and flowers	21
Strawberries	16
Miscellaneous	14
Total "other crops"	100

Cattle form the major livestock enterprise, although receipts from this source amount to less than 15 per cent. of gross incomes. Pigs, representing about 7 per cent. of gross incomes, are the

second most important type of livestock, while poultry and dairy produce are, as will be seen, relatively small items, and sheep account for less than 1 per cent. of the total. Although the sales of all livestock and livestock products represent only about a quarter of the total gross incomes, they approximate

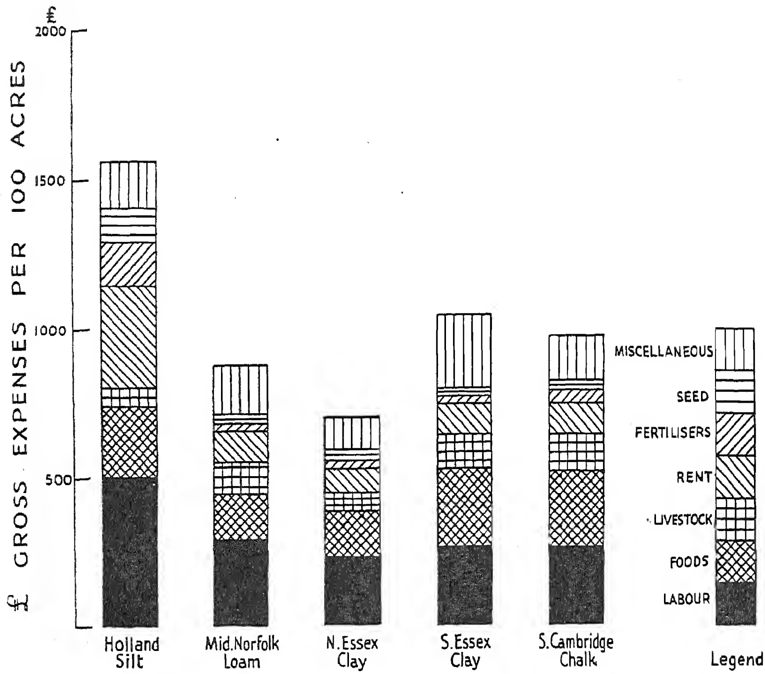

DIAGRAM V.—Comparison of Gross Expenses in five districts.

as much as £5 an acre, compared with an average of about £6½ on the four upland districts. That is, although livestock contribute only a small *proportion* of gross incomes on the silts this is due more to the intensity of crop production than to a low output of livestock.

Gross Expenses.

Expenses on the silt farms average £15½ per acre of farmed land, or £22 per acre of arable. These figures are more than 50 per cent. higher than on neighbouring upland districts (see Diagram V). The principal item of cost is labour, which, including family labour other than that of the occupier, averages 100/- per acre. Rent is the second most important item of cost and,

including the tenant's share of drainage rates, approximates 70/- per acre. These figures compare with roughly 50/- per acre for labour and 20/- per acre for rent in adjacent upland districts. It is interesting also to note that the rent and drainage rates per acre on the silt farms average nearly £1 more than those on the peat sample of farms reviewed in the previous issue of this *Journal.* Expenditure on feeding stuffs, at 50/- per acre, may seem surprisingly high for the silts until it is remembered what a relatively small proportion of the farmed area is under fodder crops. Practically no barley or fodder roots are grown, while the oats are mostly chaffed unthreshed for horse feed. Thus, apart from a small amount of grazing, some seeds hay, and various crop by-products (*e.g.*, chat potatoes and tail wheat), nearly all the feeding stuffs required for the cattle, pigs, and poultry have to be purchased. In the upland districts, on the other hand, much larger quantities of home-grown feeding stuffs are produced, and the farmers are relatively less dependent on purchased concentrates. For example, for every £100 worth of livestock produced from the silt farms roughly £55 worth of purchased foods was used, while for the upland groups of farms only £40 worth of purchased foods was required to produce £100 worth of livestock.

Expenditure on fertilisers is remarkably high on the silts (even higher than on the black peats), averaging 30/- per acre of farmed land, or 40/- per acre of arable. These figures are roughly five times as great as on upland arable farms. Of the total expenditure on fertilisers 75 per cent. is on behalf of potatoes and 20 per cent. for sugar beet. More than nine-tenths of the fertilisers are purchased as proprietary or other mixtures. The average dressings applied to potatoes, sugar beet, and wheat on the 45 silt farms are given in Table II, which shows clearly that potatoes are the most favoured crop. Nearly three-quarters of

Table II.—Distribution of manuring on three principal crops on Silts.

—		Potatoes.	Sugar beet.	Wheat.
Dung.				
Per cent. crop area dressed	.. %	73	5	4
Av. dressing per acre ..	.. loads	16	11	10
Ready-Mixed Fertilisers.				
Per cent. crop area dressed	.. %	100	67	—
Av. dressing per acre ..	.. cwt.	15	9	—
Nitrogenous Fertilisers.				
Per cent. crop area dressed	.. %	—	11	13
Av. dressing per acre ..	.. cwt.	—	2	$1\frac{1}{4}$

the potato acreage gets dung at an average rate of 16 loads per acre, while the entire potato crop is dressed with fertiliser at an average rate of 15 cwt. per acre. As compared with this only 5 per cent. of the sugar beet gets dung, although two-thirds get fertilisers at the rate of 9 cwt. per acre, and a small proportion gets some nitrogen. None of the wheat gets any balanced fertiliser, and only an insignificant proportion gets dung or nitrogen.

Expenditure on seed is also high on the silts, averaging over 20/- per acre, mainly as a result of the large acreage of potatoes and the need for importing fresh seed from Scotland, usually every alternate year.

Gross Output.

Gross output is a measure of the value of the goods actually produced, and is generally calculated by the formula: sales *minus* purchases of livestock *plus* or *minus* change in valuation. In the present instance purchases of feeding stuffs have also been deducted from sales in order to arrive more closely at the productivity of the farm, and to secure closer comparison between districts in which dependence on purchased feeding stuffs is variable.

The value of the gross output per acre on the silt farms under review averaged £16 per acre in 1937,[1] or rather more than double that on the other four districts in the Eastern Counties with which comparisons have been made (Table III). This relatively large output illustrates the intensity of production on the silts. It is achieved partly by concentrating on "high-value" crops (particularly potatoes) and partly by high yields per acre. The latter are in turn due largely to the natural

Table III.—Gross Output per 100 acres, per manual worker, and per £100 Farm Capital.*

District.	No. of farms in group.	Av. size of farms.	Gross Output.		
			Per 100 acres.	Per worker.	Per £100 farm capital.
	No.	Acres.	£	£	£
Holland Silts	45	87	1,600	260	65
Mid-Norfolk loams	45	126	700	200	65
North Essex arable clays ..	45	177	600	220	60
South Essex pasture clays ..	45	150	800	280	80
South Cambs. chalks	45	188	750	260	62

* Gross Output = Sales *minus* purchases of livestock and feeding stuffs *plus* or *minus* change in farm valuation.

[1] Potato prices were relatively low for the 1937 crop: see footnote on page 68.

fertility of the soil, but liberal applications of fertilisers and good management contribute to the result. Further, in spite of the small area of the farms, the output per worker compares favourably with that on the mid-Norfolk loams and north-Essex arable clays, and is equalled or exceeded only on the south-Cambridge chalks, where farms are double the area, and on the south-Essex clays, where pasture dairying is common. Lastly the rate of capital turnover on the silt farms (as measured by the ratio of gross output to farm capital) is exceeded only in the pasture dairying district of south Essex.

4. Some Individual Farms.

In the previous pages the environment and organization of farming on the silts has been sketched in general and somewhat discursive terms. The following brief description of the organisation of three individual holdings—a small, a medium sized, and a large farm—provide a certain amount of detail which may fill in some obvious gaps in the earlier outline. It is always dangerous, and nowhere more so than in farming matters, to argue from the particular to the general. But having got some idea of the general organization of farming in the district, readers may judge for themselves how far, and in what respects, the following three holdings are typical.

Farm A is a small holding of about 20 acres, and the Michaelmas valuation of livestock, crops, and equipment approximates £35 per acre. There are no regular employees, but casual help is hired for beet hoeing, and for the potato, root-seed, and beet harvests. For 1937 this casual labour cost about £60. The occupier works full time all the year round, and his wife assists at busy periods. There are three work horses, of which one is a youngster being gradually broken in to replace the oldest. The rent is 70/- per acre plus 7/- per acre drainage rates.

The 1937 cash crops comprised 5 acres of potatoes, 5 acres of sugar beet, 3 acres of swede seed, 1 acre of green peas, while 1½ acres of oats and clover were grown for fodder. Of the potatoes 3 acres were Majestic and 2 acres Doon Star. The Majestics were grown from Scottish seed costing £7 5*s*. a ton, and 4 tons were required to plant the 3 acres. All the seed was chitted, and preparatory cultivations included ploughing 10 inches deep. A balanced fertilizer costing £8 10*s*. a ton was applied to the whole crop at the rate of 20 cwt. per acre. The quantity of potatoes actually sold off the 5 acres totalled 45 tons, made up of 34 tons ware, 6 tons seed, 3 tons "seconds," and 2 tons of "chats," and the total receipts amounted to £170, or £34 per acre. The average selling price of the potatoes was thus just under £4 a ton, but this included, of course, a small quantity of seconds and chats. The chats were sold to the

Farmers' Marketing and Supply Company's Factory at Wisbech and made £1 per ton. The sugar beet crop yielded at the rate of $20\frac{3}{4}$ tons gross or $16\frac{3}{4}$ tons washed beet per acre, with an average sugar content of 17 per cent. This crop had been given 4 cwt. per acre of concentrated fertilizer costing £11 10*s*. a ton, while a part of it had also been dunged. The swede seed yielded at the rate of 21 cwt. ($10\frac{1}{2}$ sacks) per acre, which fetched 40/- per cwt., giving total receipts of £42 per acre. This is, of course, an exceptionally good yield, but was needed to compensate for a 4 cwt. yield in an earlier year. The area of green peas was a complete failure. The clover was cut for hay, while the oats were chaffed unthreshed for horse feed. Total crop sales approximated £500.

Apart from the work horses, the only livestock on the holding is one cow to supply milk for the house, and about 50 poultry. In addition, the cow's calf was reared, while the previous year's calf was finished off and sold fat during the current year. Total livestock sales amounted to less than £50, while about £25 was spent on purchased feeding stuffs. Amongst the miscellaneous expenses beet haulage was the chief item.

Farm B is a middle sized holding of about 80 acres, and the Michaelmas valuation of stock, crops, and equipment approximates £30 per acre. The regular employees comprise one stockman, one horseman, two ordinary labourers, and one low-pay worker, while in addition about £100 is spent on casual labour. Traction power is supplied by 4 work horses and a 10-20 h.p. wheeled tractor. The rent is 50/- per acre plus 3/6 for drainage rates.

The 1937 cash crops comprised 21 acres of potatoes (5 acres Majestic, 16 acres Arran Banner), 6 acres sugar beet, 6 acres swede seed, 15 acres wheat, and 3 acres strawberries. The fodder crops were 6 acres oats, 3 acres seeds hay, 5 acres temporary grass folded by sows, and about 7 acres of permanent grass. The whole potato acreage had 8 cwt. per acre of a concentrated fertilizer costing £11 5*s*. per ton, in addition to 15 loads of dung per acre. All the seed is chitted in a glasshouse 26 ft. by 22 ft. This house is large enough to hold 26 tons of seed potatoes and during the summer is used for growing tomatoes, of which up to 12 cwt. may be picked between July and September. The yield of potatoes (ware and seed) averaged $9\frac{1}{2}$ tons per acre, the Arran Banner yielding 10 tons, and the Majestics being a disappointing crop at 7 tons per acre. The field in which these latter were grown was badly flooded in the spring. The sugar beet had 3 cwt. per acre of nitro-chalk, and yielded 13 tons washed beet per acre with a sugar content of $15\frac{1}{2}$ per cent. This sugar content was unusually low, for in a normal year it generally approximates $17\frac{1}{2}$ per cent. The swede seed received 2 cwt.

per acre of nitro-chalk and yielded 17 cwt. ($8\frac{1}{2}$ sacks) of seed per acre, which realized 40/- per cwt. The wheat had 2 cwt. per acre of nitro-chalk and yielded at the rate of 4 qrs. per acre. The 3 acres of strawberries realized £220, yielding about $1\frac{1}{2}$ tons of fruit per acre which averaged *5d.* per lb. Total crop sales approximated £1,300, or an average of £$25\frac{1}{2}$ per acre of cash crops.

In addition to the horses the only livestock are pigs, and about 15 sows were kept during the year. The sows run out on grass during the summer, although they are brought into huts for farrowing. The young pigs are brought on and fattened, generally for bacon, and for this purpose a useful Danish-type fattening shed is available. All pig food is purchased, and for the year the cost of food worked out at about £85 per £100 pig output, leaving a margin of only £15 for labour and maintenance costs. This result was not satisfactory and was largely due to the high price of foods, but it must be borne in mind that the pigs were the only source of dung, of which a considerable quantity is required for the potatoes.

Farm C. This is a large farm of about 500 acres, and the Michaelmas valuation of crops, livestock, and equipment approximates £25 per acre. There are about 25 regular employees and in addition a number of casual workers are employed in spring and autumn for the potato, sugar beet, and seed crops. Traction power comprises 20 work horses, 2 tractors (1 track laying and 1 wheeled), and a 40-cwt. lorry. The rental value of the farm is 60/- per acre plus 4/- drainage rates.

The 1937 cropping included 120 acres of potatoes (82 acres Majestic, 20 acres Eclipse, 7 acres King Edward, 6 acres Doon Star, and 5 acres Queen Mary), 55 acres sugar beet, 100 acres wheat, 25 acres barley, 50 acres canning peas, 10 acres white mustard, and 2 acres of strawberries. All these crops were cashed, and in addition 20 acres oats, 45 acres clover and mixtures for hay, and 5 acres mangolds were grown for fodder, while there were about 75 acres permanent grass.

Over £1,000 was spent on fertilisers. The potatoes alone had 15 cwt. per acre of a balanced mixture costing £8 a ton, while the sugar beet and peas each had 10 cwt. per acre at the same price. Half the potato acreage received dung in addition to fertiliser. About 100 tons of seed potatoes were bought for the 1937 crop at a cost ranging from £6 to £8 a ton, and all the seed was chitted before planting. The quantity of potatoes marketed averaged over 10 tons per acre, the Majestics giving 11 tons and the other varieties about 9 tons. The sugar beet yielded 12 washed tons per acre, and the wheat gave 5 qrs. per acre. The peas (varieties Gregory Surprise, Lincoln, Charles I) produced about 27 cwt. per acre, but the mustard was a disappointing crop at only 4 sacks per acre. Total crop sales were

in the neighbourhood of £8,000, of which potatoes contributed more than half.

In regard to livestock about 15 cows are kept for calf rearing. The policy here is that each cow rears at least 2 calves per lactation, viz., her own calf plus one and possible two others purchased. The calves are weaned at 4–5 months old when they go on to a bean-and-oat mixture, going out to grass in the following season, and subsequently being sold as down-calving heifers or as fat beef. In addition to this rearing enterprise a score or so of store cattle are bought for fattening. A small flock of about 50 ewes is carried, while a flying flock of perhaps 5 score of hoggetts is bought in to help clean up the sugar beet tops. About 10 sows are also kept, and the progeny fattened for bacon. These pigs help to utilise chat potatoes, which are cooked before being fed. Lastly there are about 100 poultry which help to convert tail wheat into a marketable product.

It has been noted earlier that only a small quantity of fodder crops are grown. The oats are required for horse feed, so that pasture, some hay, and a few acres of mangolds are all that is available for the "productive" livestock. It is true that chat potatoes, tail corn, beet tops, and seeds aftermath provide a certain amount of fodder, but in addition about £1,000 worth of purchased foods is required. It is perhaps worth observing, however, that even though the livestock left no direct visible profit, they would still perform a useful function on this essentially cropping farm by providing the dung so necessary for maintaining the fertility of the soil.

Acknowledgments.

It is a pleasure to acknowledge the co-operation of the farmers in the parishes of Moulton and Whaplode who provided the basic information on which Section 3 of this article is based. The arduous task of collecting the farm records was undertaken by Mr. P. Hathaway. Assistance in the enumeration of the small holdings was kindly given by the Spalding Police Superintendent. Much helpful advice in regard to the general design of the study was obtained from Mr. J. C. Wallace, Principal of the Kirton Agricultural Institute and Agricultural Organiser for Holland, who has also been good enough to read the proofs, and to make many useful suggestions.

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P. E. Graves.

School of Agriculture,
Cambridge University.
July, 1938.

NOTABLE FARMING ENTERPRISES—IX.

The Warnford Farm Estate.

Warnford is a small village dating back to Doomsday Book. It is situated in the Meon Valley, on the Alton–Gosport road, 60 miles from London, 9 miles from Winchester, and 11 miles from Petersfield. It lies at the foot of wooded downland midway between, and slightly north of, the two hills made famous in Cobbett's *Rural Rides*—Old Winchester Hill to the east and Beacon Hill to the west; the River Meon runs through the village.

The Warnford Estate was purchased by Mr. R. P. Chester in 1935, and the greater part of the land was occupied by him in January, 1936. The area is approximately 1,000 acres, of which only 600 acres can be regarded as effective agricultural land in the sense that it has been cultivated in the past. The remainder is either wooded, or is too precipitous, or has insufficient depth of soil to make cultivation a practical proposition. Actually, at Michaelmas, 1935, the ingoing valuation totalled only some £130, the items being two ricks of hay, two ricks of wheat straw, and one rick of oat straw. No other crop had been grown that year, and the total area under the plough was only some 40 acres.

A valuation at September 1938 showed that there were then 5,911 pigs of all ages on the farm, that an area of 400 acres was in regular arable cultivation, and that a staff of 50 men was being kept in regular employment.

These figures give some indication of the rapidity of the development which has occurred, and which is still proceeding. The speed of development makes it rather difficult to describe the venture as a whole.

The most striking feature of the estate is the vast scale on which pig-breeding and bacon production are conducted, but—scale apart—both the general system and the details of pig management should be of interest to those dealing with more ordinary numbers. Many points in the organization of pig production are more fully appreciated when the business is run on mass-production lines, but the same points may be worthy of attention under more ordinary circumstances. The aim at Warnford is to introduce modern business organization without sacrifice of the detailed and skilled individual attention which is the essence of successful animal husbandry.

Next to the scale of the business, the speed with which it has been built up is, at first sight, its most noteworthy feature; but what is more remarkable is the rapidity with which the

various difficulties have been appreciated, and met by appropriate changes in the management. Again, and apart from the pigs themselves, there is much of interest in the reclamation of the derelict land and in its rapid conversion to arable through pig folding and cultivation.

The economic interest of the experiment is not confined to the particular estate. From the standpoint of the Nation it suggests the possibility of the profitable re-employment of "city" money in English Agriculture—provided always it is invested with intelligence and knowledge. That new capital should be made available is of paramount importance at the present time if an increase of home food production is to be brought about; on the assumption that economic prices are to be maintained, the greatest stumbling block to agricultural progress is the lack of capital among the present occupiers of the land of this country.

Policy and General Management.

The Warnford Estate has been developed with the dual object of providing first-class shooting and of making it a profitable farming venture. An annual production of 10,000 bacon pigs for the factory is envisaged, in addition to numbers of breeding animals, surplus to herd maintenance requirements, which are sold privately. The pigs, together with the corn crops from approximately 200 acres, provide practically the whole of the farm revenue.

The pig is being used to replace the sheep in the traditional farming system of the district, *i.e.*, as a meat producer, a source of animal manure, and a means of consolidating the soil. Artificial fertilisers and, of course, adequate cultivations also play their part in arable crop production, which is, needless to say, an essential for good shooting.

Mr. Chester is a successful business man who has always been a keen naturalist and countryman. His enthusiasm for farming is unbounded, and since his purchase of the estate he has given the major part of his time to the close supervision of its business management. Two years ago the owner appointed an experienced Sussex farmer, Mr. C. F. Lock, as Bailiff and Manager, and the latter has been responsible for the field policy of stocking and cropping.

A simple laboratory has been set up on the estate, and here the routine testing of food stuffs, etc., is performed by an analyst. For the past year a good deal of time has been devoted to the investigation of anæmia in young pigs. This work has been carried on by Mr. R. Gilbert Harris, whose medical training had been interrupted by illness, and who has made use of this training in these experiments. An article by him, giving a

preliminary account of the experimental results, appeared in the *Pig Breeders' Annual* for 1938–39, and a summary of this, and of later work, in the *Farmer and Stockbreeder* during October, 1938. A comprehensive series of records of the breeding, live weights, food consumption, etc., of the pigs, together with costings of all the estate enterprises, is kept in a centrally situated office with a staff of three. The outside staff is organized into 4 main groups—estate, shoot, farm and pigs. The estate staff of 7, including carpenters, an electrician, a painter and a storeman in addition to the woodmen, is capable of dealing with all ordinary maintenance repairs and fencing; there are 3 gamekeepers; the seven farm men consist of 4 tractor-drivers, 2 carters and a labourer; 30 men are employed on the pigs, subdivided into groups corresponding with the various groups of pigs. Ease and efficiency of working have been obtained by a well-considered layout of the buildings, the majority of which are new.

Soils.

Mr. Chester's property extends westward from the village of Warnford, the land varying in height from 220 feet to 550 feet above sea level. The whole area overlies the Upper Chalk, and the range of soil types is that characteristic of the formation. On the tops of the hills there is a deposit of Clay-with-Flints, producing a reddish-coloured, sticky soil containing large flints. This soil is neutral or slightly acid and is one that requires careful handling. Most of the area covered by it is in copse, there being only 50 acres under cultivation. Near the valley is a small area of gravel terraces, and on the steep slopes of the hills the soil is not only shallow but is largely made up of flints and chalk.

Over the greater part of the agricultural portion of the estate the soil varies in depth from about five inches to a foot, but it is practically of one type—the type which was farmed, in Hampshire for some hundreds of years until the twentieth century, under the intensive arable-and-sheep system. It is a light loam, free draining, easy to cultivate after rain and requiring frequent consolidation. The following figures from a chemical analysis of a Warnford soil sample represent a fair average of the type, and indicate both an acute deficiency of potash and very ample supplies of both phosphate and lime—an extremely ill-balanced ratio :—

Calcium carbonate	30·04 per cent.
Available phosphate	0·031 ,,
Available potash	0·005 ,,

Potash is thus the primary need in the way of artificial fertilizers.

Record of Progress.

The progress during the past two and a half years can be best summarized under a number of headings.

In regard to estate work, two of the ten cottages were found to have been too long out of use to be worth repairing, but the eight others, and the farmhouse, have been renovated. The two sets of farm buildings were also in dilapidated condition; some of the worst were pulled down, while the remainder were brought into a thorough state of repair. One of the yards was found impassable owing to springs of water, which had to be drained; thereafter many hundreds of tons of chalk were carted in to make the yard dry. The programme of new buildings, including ten cottages and the several pig buildings, is only recently completed—the whole of this work having been done by outside firms.

An estate water supply was installed, with pipes to the cottages, farm buildings and the main points on the farm. A bore was sunk and storage tanks were erected for 80,000 gallons. Before this supply was available cottagers had been obliged to carry water in buckets from the river.

Field work during the first year was concentrated on bush pulling with tractors and the restoration of hedges. The latter were reduced to their original dimensions by pulling out the spreading growth, and were then cut and laid. Large areas of what had once been arable fields were cleared of bushes, and one enclosure of 60 acres was subsequently cultivated by means of the largest (30 H.P. model) Gyro Tiller; this is a peculiarly effective implement for dealing with ground in which there are many broken remains of roots. Probably the area of densest bush and bramble growth was in the vegetable garden of the farmhouse, through which even dogs were unable to penetrate.

One of the greatest problems was presented by rabbits; in order to bring these under control it was necessary to wire the whole boundary of the property, and then, by an intensive and patient campaign of trapping, ferreting and shooting, to exterminate all those inside. The number killed during the first two years exceeded 20,000. Needless to say, the cleaning up of the hedges and the clearing of the overgrown areas were essential accompaniments to the killing.

The first pigs were purchased in April, 1936, and during the summer of that year large numbers of pedigree Large White and Wessex Saddle Back breeding animals were obtained from many of the best-known herds in the country. In the first instance all the pigs were kept out of doors on the land, in folding units with attached runs, which were moved daily. While this

system was later modified for animals of certain ages and, indeed, for all growing pigs, it meant that, in the first year, a considerable acreage of land was folded. Where possible, the folding was repeated, two or three times, over the same land. This was the first process in the reclamation of land which was derelict or out of cultivation. During 1937 the original 40 acres under the plough was extended to 187 acres, and embraced 90 acres of fair wheat, 75 acres of spring-sown oats and barley—some of which was poor—and 6 acres of good mangolds.

Following the pig folds, the reclaimed land was cropped with either autumn or spring corn, liberal dressings of kainit being applied to every crop.

Wireworm has been a serious trouble in some of the first season's crops, and particularly in spring corn. It seems to have caused the most severe damage in oats and barley sown on land which had been folded, when wet, by pigs and which had consequently been puddled. The presence or absence of this pest in particular fields has been, as usual, difficult to explain. Normal measures for prevention or cure have been applied—sowing as far as possible under conditions which have favoured rapid growth, and thorough compression of the soil by using the presser behind the plough and afterwards by rolling with a ring roller. Top dressings of nitrogenous manure and repeated rollings in both directions have been used where necessary.

The past season's field cropping may be regarded as a half-way stage between reclamation and a permanent system; the following is a summary of the crops :—

Wheat	110 acres
Barley	30 ,,
Spring oats	12 ,,
Mixed rape and kale	45 ,,
Mangolds	14 ,,
One-year ley	75 ,,
Fallow, following rape or mustard ..	40 ,,

The wheat was undoubtedly a good crop and looked like yielding an average of 11 sacks—though estimates of yields are often wide of the mark, especially in outstandingly good wheat years such as 1938.

Barley was poor; it suffered from wireworm in patches, and also from being sown too late to avoid the ill-effects of the drought. The oat crops were useful, and both the green and root crops when seen in the autumn were full of growth, and well above the average for the district and the year. The clover and rye-grass ley was all grazed by the pigs.

Since the initial large-scale purchases of the first months, outside buying of pigs has been confined to boars and a relatively small number of carefully selected females. Otherwise the

increase of the herd has been effected by retaining home-bred stock.

As a result of the first winter's experience of farrowing some hundreds of sows in individual folding houses, it was decided to modify this system of management, and the sows have since been brought into permanent houses before farrowing, and turned out again after being served. There were a number of considerations which led to this decision, either concerned with the well-being of the animals themselves, or with questions of cost. Particularly during periods of severe cold, wet, wind, or snow it was found difficult on the open chalk fields to maintain reasonably warm and dry conditions at the critical times, *i.e.*, at and immediately after farrowing, and losses of newly-born pigs were considerable; again, the conditions under which the pig-men were forced to work did not conduce to close individual supervision; observation of the young litters was found to be difficult; and, lastly, the control and recording of service dates was not satisfactory. Such control is essential if an even flow of litters is to be maintained. From the standpoint of cost, the labour involved in the daily move of the folding houses, and of the wooden hurdles which were attached to form the runs, proved prohibitive. Besides, the damage to equipment on muddy arable ground, or worse still during frost following wet, was very great.

The present system was evolved by stages during 1937, since when new building has been confined to the provision of extra accommodation of each of the types required for the growing numbers of pigs.

It will be appreciated that the above decisions have been reached in consideration of the special conditions at Warnford—the large numbers involved, the general character of the farm, and the original object of keeping pigs as the principal agents to restore and maintain the fertility of the land. With a breeding herd of average dimensions, and with convenient, well sheltered and well drained grass or arable fields available, the same objections to the outdoor system will not arise. In fact, the exact system of stock or crop management must be worked out for each individual farm.

Arable Land.

While further stretches of less easily accessible and otherwise more difficult downland may be brought under the plough in the future, there is some finality in the acreages which will come under crops in the immediate future, and a review of the present position gives a fairly accurate picture of the system which it is proposed to follow.

The rotation of crops is not easy to summarize, but it may possibly be most clearly set out as in years as follows:—

1st Year	..	Wheat (undersown).
2nd Year	..	Clover and perennial ryegrass, part ploughed and followed by mustard or rape. Alternative trefoil and Italian ryegrass followed by rape.
3rd Year	..	Wheat.
4th Year	..	Winter vetches followed by mixed rape and turnips.
5th Year	..	Wheat.
6th Year	..	Spring corn (barley or oats).
7th Year	..	Mangolds or kale.

Any rotation in which a large number of catch crops is introduced must be subject to seasonal opportunism and to a great deal of modification, but in essence this rotation results in rather over 50 per cent. of the land being in corn, gives a fair proportion of leguminous crops, and provides roots or green crops for pig folding throughout the year. It also arranges for the alternation of cereals with folded crops. The only exceptions to the latter rule are that barley (sometimes oats) follows wheat, with the object of producing an even and high-quality malting sample; and that the kale and mangolds are carted to pigs, either on stubble or pasture. The succession of green crops is planned for folding in the following order:—

Trefoil and Italian ryegrass in late April.
Clover and ryegrass—May to October.
Winter vetches—late May or early June.
Spring vetches—later in June.
Broadcast rape—June to September.
Rape and turnips—September to December.
Kale and mangolds—January to May.

In the choice of plant varieties there are few points in which any departure is made from the established good practice of the area. White wheats, of the Wilhelmina type, have been found satisfactory in the main, with Little Joss for late sowing. The barley is either Plumage Archer or Spratt Archer. The mixtures for one-year leys conform to usual practice.

The system of manuring is simple. Farmyard manure from the large pig houses is clamped under cover and is afterwards carted and spread by means of two International dung-spreaders, which have satisfactorily handled the somewhat "short" and concentrated manure. A heavy dressing is applied to both mangolds and kale, and these crops have so far absorbed most of the dung available. As already indicated, the potash deficiency of the soil is very marked, and a dressing of 4 cwt. kainit per

acre has so far been applied to all crops; it will be necessary to continue this practice for some years, at any rate on the main crops. Applications of nitro-chalk are used in the spring as wanted—normally at the rate of 1 cwt. per acre for corn, and 2 cwt., in two dressings, for roots. Small quantities of superphosphate have been applied—at the rate of 2 to 3 cwt. per acre—to the mangolds and kale only.

The power unit consists of five standard-model Fordson tractors and four horses; two of the tractors are largely occupied in the internal haulage of fattening pigs or of other commodities on the estate. The range of implements consists of usual types of ploughs, pressers, cultivators, harrows, rollers and binders, and there is no point of special interest in this connection.

Pigs.

The map of the estate on the opposite page gives an indication of the position of the various pig houses relative to each other, to roads and buildings, and shows the layout of that portion of the estate which is in hand.

Before turning to the system or any of the details of management, there are a few general points in regard to the layout which are worth noting.

Buildings.—The house and office are together, situated centrally on the main east-and-west road and within easy reach of the farrowing, rearing and weaner groups of houses, for which the greatest supervision may be expected to be necessary. It will be seen that the houses are grouped into five blocks, at distances which make for reasonably easy communications, and yet make the isolation of any group a practical possibility. Each group is separately served by its own labour staff, and facilities for disinfection are provided at the entrances of every block. The importance of taking all reasonable precautions against disease is obvious, in view of the numbers of animals involved; the object of the layout is to confine a possible outbreak of swine fever, or of some other highly infectious disease, to one section of the herd. The unit of labour for each block is of convenient size for supervision, and is large enough for a regular system of reliefs, or to carry on in the event of absence of a man through illness.

All buildings have good access to hard roads and are handy for the disposal of manure. Lastly, the distances travelled by pigs, on their successive moves to different parts of the farm, are reduced as far as possible.

The layout and the amount of accommodation are designed for a self-supporting herd producing 10,000 bacon pigs per annum, or nearly 200 every week. The assumption is that the

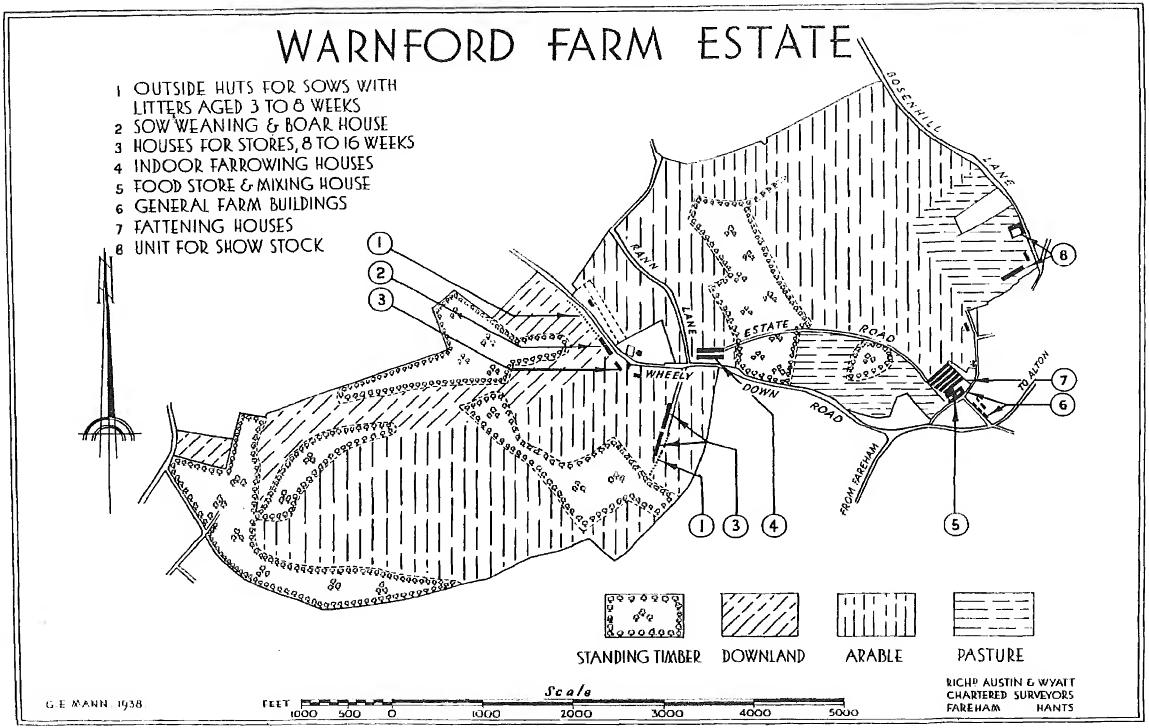

Fig. 1.—Warnford—General Lay-out.

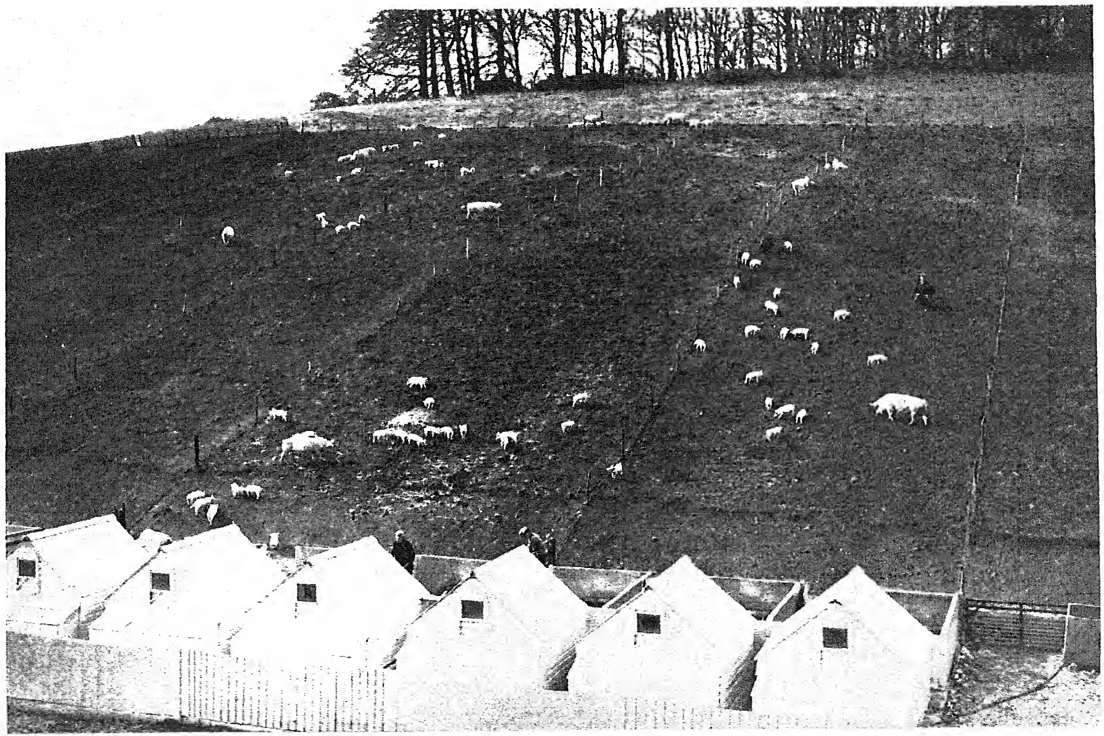

Fig. 2.—Warnford—Rearing Huts and Runs on Downland.

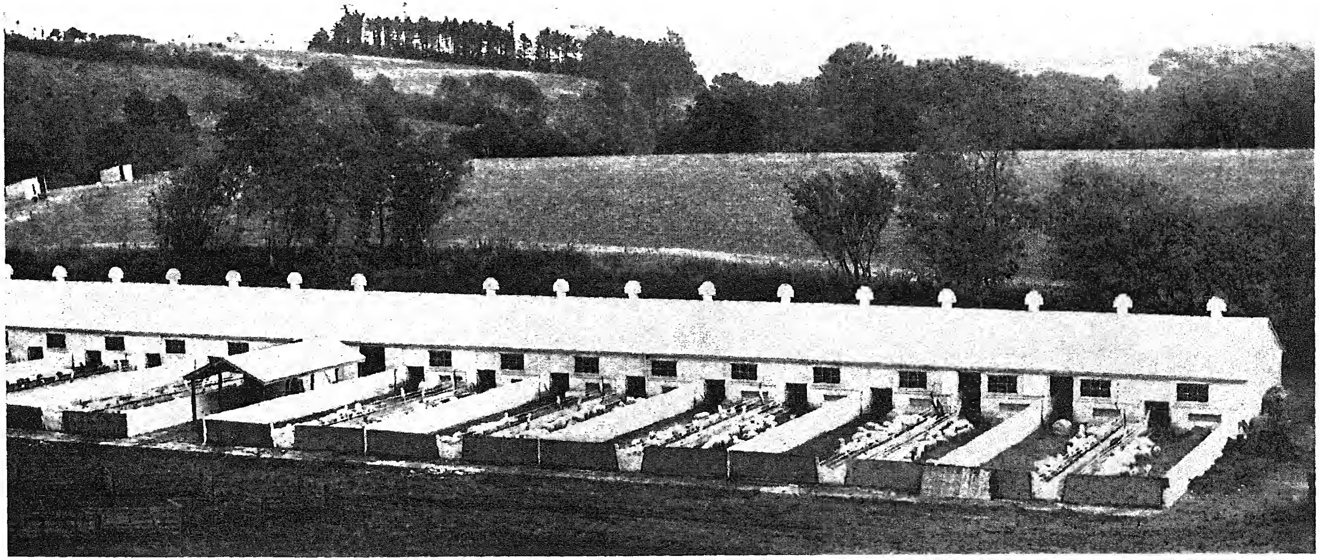

Fig. 3.—Warnford—A Weaning House.

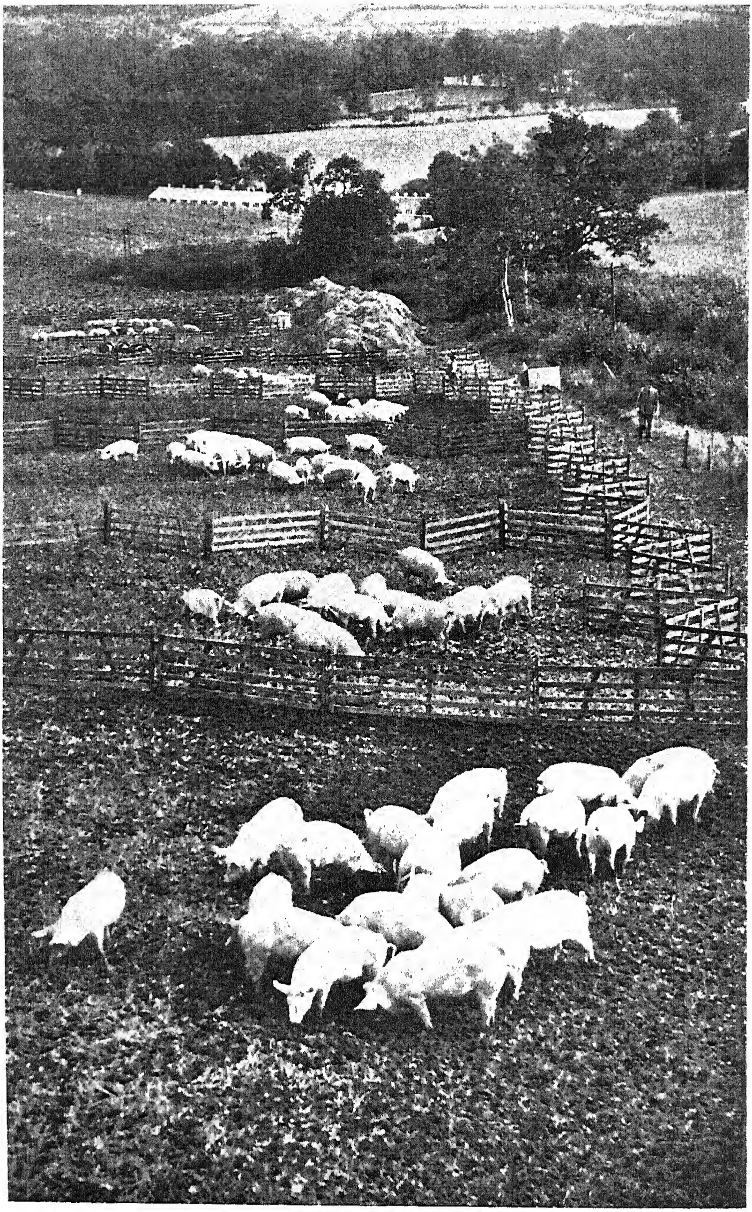

Fig. 4.—Warnford—Sows and Gilts in Folds.

average age of the 8-score "Wiltshire" bacon pig is 27 weeks, and its life is divided into three roughly equal periods of 9 weeks. In order to provide a margin of safety, housing capacity is required of 2,000 pigs at each of the three stages, *i.e.*, for 6,000 pigs in all. The housing is made up as follows :—

1. Two indoor farrowing houses, with a total of 112 pens, for pigs from birth to 3 weeks of age.

150 semi-permanent huts with runs, for pigs from 3 to 8 weeks old.

2. Three houses for weaners, in pens of 50 each, for pigs from 8 to 18 weeks old or up to 100 lb. live weight.

3. Five fattening houses each with 42 pens, for 10 fattening pigs of 18 weeks to 27 weeks, or up to 210 lb. live weight.

It may be of interest to note that on September 30th, 1938, the actual numbers of stock valued in the three above groups were :—

Group 1—1,737 suckers,
Group 2—1,656 growing pigs, and
Group 3—1,633 fattening pigs.

This shows that the output aimed at is being approached, and that the plant is already working at over 80 per cent. of its intended capacity.

Farrowing.—The sows are brought from the outside folds to the farrowing houses from 7 to 14 days before the dates when they are due to farrow. The houses are built on the Scandinavian plan, with two rows of pens 10 feet by 10 feet divided by a central feeding pasage 4 feet wide and with dunging passages, 3 feet 9 inches in width, next to the side walls. Ventilation is by means of extractor cowls in the ridge and inlets in the side walls just above ground level as well as by windows. These means provide for standard ventilation requirements, *i.e.* a change of air eight times per hour. Floors and internal pen divisions are made of concrete, troughs of glazed pipes in concrete, and the fronts of the pens of horizontal galvanised piping. Regular cleaning out, and a thorough disinfection before fresh animals are brought in, are therefore made easy.

The most interesting structural feature is a hot-water installation which is operated, in winter, so as to maintain an even temperature of 55 degrees Fahrenheit. In both houses there is a low-pressure coke boiler connected to a circuit of 4-inch cast-iron piping suspended from the roof above each row of pens. This forms a gravity-fed hot-water circulation. The estimated cost of heating amounts to less than 4*d*. per piglet for the first three weeks of its life, *i.e.* up till the time of its removal from the farrowing houses. Mr. Chester is definite in his

opinion that this is money very well spent, chiefly because losses of young pigs in the first few days of their lives, from crushing by the sow, are greatly reduced. To anyone walking through the houses it is a matter of interest to see the piglets lying down comfortably asleep at some distance from their mothers, and it would certainly appear that the expenditure is amply justified.

Meal is fed dry twice a day, and water is always in front of the sows. The basis of quantity is an allowance of 2 lb. for the sow and 1 lb. for every pig in the litter. Green foods, or mangolds, are also fed daily. The routine of cutting any teeth, within 48 hours of birth, and of tattooing or ear-notching the pigs when a fortnight old, is regularly attended to.

Reference has already been made to the experimental work carried out at Warnford on anæmia in young pigs—a disorder which is prevalent in winter litters and is too well known to require description. The evidence obtained of the occurrence of the trouble was equally striking whether measured in terms of hæmoglobin values of the blood during the first 8 weeks, in the officially recorded weights of pigs at 6 weeks of age, or in an inspection of treated and untreated litters. Regular daily and individual dosing of every young pig between the ages of 3 and 21 days is now an established practice. By using an automatic measure on the top of a reagent bottle, and by reason of the ease of handling in the farrowing houses, the time occupied is surprisingly small. A daily dose of one teaspoonful ($\frac{1}{8}$ ounce) is given, and this contains 30 milligrammes of iron sulphate and 5 milligrammes of copper sulphate.

The uniformity, in condition and size, of pigs in the litters is very obvious to any visitor.

Rearing Huts and Runs.—The sows and litters are transferred to the rearing huts when the latter are three weeks old. Folding huts of the usual type, 8 feet by 8 feet, have been fixed on concrete platforms, and have yards 12 feet by 10 feet enclosed with concrete walls, and troughs for water and food. At the opposite end is a creep in which food is always available for the young pigs, up to a maximum allowance of 2 lb. per day each. Further runs, 50 yards in length, are provided on the down beyond, and to these the sows and litters are given access during the day. There is one outer run for every three huts, and care is taken that litters in each group are approximately of an age. This is, of course, easy, with four or five litters arriving every day of the year. No ill-effects have yet resulted from the continuous use of the same land for the open runs; but, in the event of trouble, either extension or shifting to an alternative site may be necessary.

Official recording of the number, sex, individual weight, and total litter weight at six weeks of age is carried out by the Hampshire Pig Industry Association. Castration is done at the

same time. The pigs are weaned at the usual age of 8 weeks, and are weighed again when shifted.

Weaning Houses.—The shell of the weaning house is identical with that of the fattening house, and each is 31 feet 6 inches in width. In the two most recently completed houses hot-water installations, of a similar pattern to those used in the farrowing houses, have been introduced, and a comparison of growth records during the coming winter should give information of interest. During cold weather the heat certainly has the effect of making the pigs spread out when they are lying down. The houses are divided into sections by cross partitions 10 feet apart, and each section has a long outside concreted yard, with troughs on either side of a total length of 50 feet; each provides ample accommodation for 50 weaner pigs. In each yard there is an automatic circular drinking trough which requires filling only at considerable periods, and is then filled with a hose. The pigs are fed with dry food three times a day, starting with a minimum of 1½ lb. and increasing gradually to 4 lb. per day. Supplementary feeding of separated milk, at the rate of one pint per pig daily, has been found to give excellent results particularly from weaning to about 18 weeks of age; but some difficulty has been found in obtaining a supply sufficient to allow of its continuance for so long. Cod-liver oil is added to the meal for the first month during the winter season, and sliced mangolds or green food are always given. Worming with Santonin is a routine measure—at a fortnight or so after the pigs have been moved in. Two further weighings are carried out during the growing period. With the completion of the quota of fattening houses it is now possible to transfer animals from the weaner houses when they have reached a weight of 100 lb., which they ordinarily do at 16 to 18 weeks old.

The housing design, and the management during the period following weaning, appear to give excellent results at what must always be a very criticial period of growth. In walking round, the absence of unthrifty undersized animals, and the general good bloom and condition, are very noticeable.

Fattening Pigs.—Five houses of the same type are again in use, each with a capacity of 420 pigs. The internal design conforms to modern Scandinavian ideas, and feeding and management follow normal routine. Dry meal is put in the troughs with a little water on top, and water is given in the troughs after each of the three meals. Emphasis is again laid on the regular disinfection of these houses, and the surfaces of internal walls, partitions, etc., are treated so as to make this easy. The weighing of pens is done monthly until the pigs approach bacon weight, when it is repeated at weekly intervals. The allowance of food

is based on a daily quantity per pig of $\frac{1}{4}$ lb. for every week of age, starting with 4 lb. and increasing to 6 lb. per day, to which last figure the allowance is restricted. Issues are made to each house weekly on this basis.

Management of Sows and Gilts.—Directly the litters have been taken away from them the sows are removed to a special weaning- and boar-house, where they are penned in lots of three, their condition watched and their individual service by the most suitable boar effected and recorded. Thence they are taken to outside folding pens on the arable land, kept in bunches of 20 within wooden hurdles and provided with rectangular wooden houses on skids, which are periodically moved. The sows are fed twice a day on a cubed concentrate mixture at a rate varying from 2 to 6 lb. per day depending on the quality of the fodder crop and the condition and period of gestation of the group of sows. Water is always available. The actual succession of crops has already been dealt with, and the mechanism of folding is precisely that of the arable sheep flock. Successive pitches of fresh ground are added daily to the fold, and a new run is made and the houses shifted when necessary, according to the state of the ground, the crop, and the cultivation requirements of the next crop.

Three "catch" boars are kept outside for use in the event of sows turning. Each sow normally remains on range for between 3 and 4 months, *i.e.*, until the next farrowing is nearly due. An average of about 600 sows will be in the folds at any one time. Pedigree gilts which are required for breeding, of either of the breeds that are kept, are selected from the fattening houses, preferably when 5 to 6 months old, and are drafted straight outside into folds in pens of 20. They are managed hereafter in a similar way to the in-pig sows except that a boar is put into each pen, for a period of 5 weeks, in time to bring the gilts down with their first litters at 12 to 14 months of age.

Rations.—The three standard concentrated rations in use at Warnford are as follows:—

	No. 1.	No. 2.	No. 3.
	Per cent.	Per cent.	Per cent.
Weatings	50	35	27½
Barley meal ..	20	35	50
Flaked maize ..	20	—	—
Maize meal	—	20	15
Vita-mealo	10	10	7½

No. 1 ration is used in meal form, for sows and litters, boars, piglets in creeps, and weaners up to 80 lb. live weight. The same mixture, in cube form, is used for dry sows and growing gilts in folds.

No. 2 ration is fed to pigs from 80 to 140 lb. live weight.

No. 3 ration is given to all fattening pigs from 140 lb. live weight until they are sent to the bacon factory.

It will be seen, firstly, that these mixtures conform closely to those commonly recommended and in general use, and, secondly, that the number of formulæ in use is reduced to a minimum. It would be difficult to overstress the advantages gained by the two latter points in actual practice, particularly when dealing with a food consumption of 60 tons per week, as is the case at Warnford. The work is simplified in many ways—in the actual purchase of the constituents, in the maintenance of requirements of straight foods or mixtures, in the organization of the store and the mixing house, and in the actual physical handling of the materials. Needless to say, there is less room for error in the mixing and issuing, and the large quantities of individual foods can be bought at lowest market prices.

A number of simple but controlled experiments have been carried out at Warnford with cheaper foodstuffs in part substitution of the standard articles, but no advantage has so far been obtained from any of the substitutes, and they have not been retained in the mixtures. Mention has already been made of the regular laboratory analyses which are carried out on the spot, and of the measure of control, in regard to the quality of the foods used, which analysis provides.

A "Porteous" mixer, of 30 cwt. capacity, is installed, and deals with all meal mixtures used; the cubing of the amount required for outdoor feeding is carried out under contract by an outside firm.

Breeding Policy and Management.—In his choice of the Large White and Wessex Saddle-Back breeds, Mr. Chester was influenced partly by the world-wide preference for the Large White in the production of the "Wiltshire" side, and partly by the fact that in the National Pig Breeders Association records these two breeds showed the highest levels of prolificacy. In these records the Wessex Saddle-Back pig showed actually the highest number of pigs reared per litter—a proof of the outstanding maternal capacity of the sows. The high reputation of the Wessex for ability to thrive under natural conditions, outdoors, was also a consideration. As already stated, the herd has been built up in the first instance by purchase, and secondly by home breeding and careful selection. All breeding animals are pedigree and officially recorded. At the present time roughly 75 per cent. of the sows are Large Whites, and the 48 boars include only the small number of Wessex necessary to maintain the supply of Wessex sows. Experience has shown that the grading results with pure Wessex are appreciably lower

than those obtained from the Wessex × Large White cross. Moreover the first-cross pigs reach bacon weight, on an average, ten days sooner than those of either of the pure breeds.

In practice, at Warnford, all Wessex gilts which are satisfactory in regard to breeding and conformation, but which are incorrectly marked, are mated with Large White boars. All first-cross pigs are sold to the bacon factory.

In order to make good the wastage of sows and to provide for herd maintenance, it has been assumed that an annual replacement of 25 per cent. of the herd will be necessary; hence 200 gilts must be introduced every year. During the past two years of rapid expansion and drastic culling, it has been difficult to decide whether this estimate will apply when the position becomes stabilized; meanwhile no difficulty has been experienced in disposing of gilts surplus to home requirements, and hence a much larger number than 200 per annum has been retained for breeding purposes. Private sales in recent months have been considerable, and the demand has shown a progressive increase. This increase may be explained partly by the fact that the herd is becoming widely known, but is partly due to the use of a system of standard prices based on age. By comparison with ruling prices for breeding stock the basis is a reasonable one, but it is remunerative compared with the price realized for baconers.

The provision of a uniform throughput of pigs, so that accommodation for all ages may be fully utilized without periodic surpluses, probably presents the most difficult problem in an enterprise of this magnitude, and its solution is the ultimate test of efficient management. The numbers of pigs in the three age groups, at the Michaelmas valuation quoted above, appear to indicate a real measure of success in this direction. The achievement of the aim clearly presupposes that the number of sows farrowing week by week shall be regular, that there shall be a constant litter average, and that an even and satisfactory rate of growth shall be maintained summer and winter until the pigs are sent to the factory. In the control of breeding, the keeping and the full use of records is essential in arranging the mating programme; and the system adopted for weaned sows, and for their individual service, has amply proved its worth.

The demand for breeding stock must always be a difficult matter to forecast; but so far as the Warnford herd is concerned the fluctuation of the demand has so far presented no difficulty. If the proportion of sales for breeding purposes should increase, the maintenance of a constant output of bacon will become more difficult.

Records.—The system of pig records is based on two types of cards which are used in the houses, and from which the office

records are built up. A *breeding card* is made out for each sow coming into the farrowing house and is attached to the front of her pen. This shows the name and number of the sow, of her sire and dam, and the boar with which she has been served. There is a cross reference to the office index card of each of the animals concerned. The breeding card is transferred in due course, with the sow, to her rearing hut, and is returned to the office when the litter is weaned. During the suckling period the date and details of the litter, the individual tattoo or notch numbers of the young pigs, their weights at 6 and 8 weeks of age, and other relevant data are entered. From these records *feeding record cards* are completed, and follow the pigs up to the fattening houses. These show their individual numbers and dates of birth, their weights on the successive dates, the pen numbers in the houses, and the pen records of weights, live-weight gains, meal consumption, and food per pound of live-weight increase, between each successive two weighings. The cards are finished with the individual dates of removal of breeding gilts or of dispatch of baconers to the factory. They are returned to the office when the last pig of the lot is accounted for.

The best proof of this system lies in the accuracy and ready accessibility of all information relating to the pigs. After a number of visits the writer is in no doubt of the efficiency of the system.

Showing.—It is not proposed to deal at any length with the show side of the enterprise, but the advantages of segregating it as a self-contained unit, with its own set of buildings and its separate staff, are clearly apparent. This arrangement not only avoids dislocation of the remainder of the farm during the summer show season, but minimizes the risk of introducing disease.

The 1938 season was the first in which Warnford pigs were regularly exhibited, and showing has been confined to animals of the Wessex Saddle-Back breed. Only eleven pigs have been brought forward, of which four were home-bred during 1937. Successes have included a First Prize and Supreme Championship at the R.A.S.E. Show at Cardiff, as well as two Breed Championships, 10 Championships and a large number of prizes at the Royal Counties, the Three Counties, Peterborough, and four different county shows.

Summary of Pig Results.—Seeing is believing, and a careful inspection of any farming enterprise will undoubtedly do more than any figures to provide a basis of judgment. Nevertheless, the following actual records for the period 1st January to

30th September 1938 are impressive, and speak for themselves :—

1. Piglets born from 1st January to 30th September 1938 6,911
2. Average number of piglets born per litter 10·42
3. Average number of piglets reared per litter .. .. 8·58
4. Average weight per pig at 6 weeks old .. 21·65 lb.
5. Average litter weight at 6 weeks .. 185·75 lb.
6. Grading figures, 1st January—30th September :

	Grade A. Per cent.	*Grade B.* Per cent.	*Grade C.* Per cent.
Large Whites	95·96	4·04	—
Large White × Saddle-Back	87·26	11·68	1·06

Conclusions.

Early in this article emphasis was laid on the fact that though the Warnford Farm Estate is, in terms of years, still in its infancy, yet when development is speeded up to the Warnford rate, is truly progressive in spirit, and is guided by the best of outside and internal experience, it seems that two years can bring into being a truly notable farming enterprise.

In a business of the size of this pig enterprise a sound general policy, adequate capital and skilled stock management are obvious essentials. It is in the organization of the mass of detailed operations, and in the successive introduction of any modifications necessary to eliminate weak links in the chain, that Warnford is outstanding. Probably the factor which is most likely to be overlooked in accounting for the success that has been achieved is the live and active interest of Mr. Chester himself, and his ability to pass on this enthusiasm to all those working on the estate.

That the margin of profit in the production of bacon pigs is a narrow one is too widely recognized to need emphasis. It is obvious that the scale of the Warnford enterprise enables a number of economies to be introduced, but these are partly offset by the risk of losses on a corresponding scale.

The points in the pig system which are of special interest are the management of the farrowing sows in the indoor heated houses; the method adopted for the control of anæmia; and the method of housing the young pigs and of handling their mothers immediately after weaning.

In regard to the system of farming the land, there is already sufficient evidence at Warnford of the extreme rapidity with which the fertility of light-loam soils, over chalk, can be raised by

folding pigs that are heavily fed with concentrated food. Under the conditions that prevail the method has advantages over sheep folding. The quantity of food used, and consequently its residual manurial value, is of course many times greater; moreover, in the initial stages, land can be evenly folded with pigs whether or not there is a growing crop.

There is indication of the growth of good crops under the rotation practised; every reason to suppose that, under the management of a skilled cultivator, the fertility level will be steadily raised; and a reasonable expectation of progessively heavier crops over a period of years.

The results from the repeated dressings of kainit again confirm experience that potash is the essential mineral requirement in crop production over the chalk area of the South; potash might well, therefore, be regarded as the basis for any national programme designed to encourage the building up of reserves of fertility in the light soil types.

Finally, it will be realized that the Warnford enterprise is founded on the best established practice. Once again the moral is clear—that success is achieved by building up, on this foundation, a system which is sound economically, which selects wisely and relates properly, one to another, the enterprises which are to be carried on, and which, last but not least, is efficiently organized on business principles.

L. G. Troup.

The Castle,
Winchester.

THE SOCIETY'S GOLD MEDAL.

Sir Merrik Burrell, Bart., C.B.E.

Few names can be more familiar to members of this Society, or to British Agriculturists in general, than that of Sir Merrik Burrell, who has, over a long period of years, devoted himself so wholeheartedly to the cause of agricultural progress.

The list of his activities is so long that it may seem impossible that any man could do so much and do it well; yet no-one who has served by his side can have been left in doubt that the quality of his work is as remarkable as its quantity.

Probably his greatest service has been to the cause of Animal Health. As Chairman of the Governors of Royal Veterinary College, of the Animal Diseases Committee of the Agricultural Research Council, and of the Veterinary Committee of this Society he has played an important part in the re-organization of Veterinary Education, Research and Administration, and has been largely responsible for many notable developments. Among these have been the rebuilding of the Veterinary College; the planning of a comprehensive scheme of research into animal diseases; the organization of a Quarantine Station for pedigree live-stock intended for export; and the acquisition, by the Agricultural Research Council, of the new Field Station for veterinary research at Compton in Berkshire.

Many other bodies owe a great deal to Sir Merrik's clear vision and sound judgment. He has, for example, been a very active member of the Council of Agriculture for England, Chairman of the Agricultural Committee of the County Councils' Association, and a very staunch friend of the Young Farmers' Club movement. He was the leader of the long campaign against the "scrub bull".

In 1936 the Society honoured Sir Merrik by electing him to the Presidency. It now gladly pays him the highest honour which it can bestow.

REPORT OF THE RESEARCH COMMITTEE.

THE Society's Research Committee has, during the past year, been able to provide funds for six research projects. Dr. Minett has continued his work on the diseases of young calves; Rothamsted has continued its investigation in which electric power is being compared with oil-engine and tractor power for work such as threshing and grinding. Dr. Thornton, of the Bacteriology Department of Rothamsted is continuing his researches on the nodule bacteria of leguminous plants. The trial, which has been undertaken at Rothamsted, to obtain evidence on the manurial residues from cake fed on pasture, is well under way. The same may be said of the grass-seed mixture trials which have been laid down in a large number of counties by Prof. Stapledon and his colleagues of the Welsh Plant Breeding Station. Mr. Lyle Stewart is able to report definite progress in his work on the control of sheep tick. The rotation experiments at the Norfolk Agricultural Station are proceeding, but some further time must elapse before it will be possible to draw any conclusions from the results. None of the schemes of research has been completed during the year, though the work at Rothamsted on the use of Electrical Power will be brought to an end in the winter of 1938–39. The following are reports of the work in progress.

DISEASES OF YOUNG CALVES.

RESEARCH INSTITUTE IN ANIMAL PATHOLOGY. ROYAL VETERINARY COLLEGE, LONDON.

In the report of the Research Committee two years ago, it was pointed out that, in the original investigation into the causes of death in young calves, pneumonia had accounted for the death of 24 out of the 100 calves that had been examined shortly after death. Of the 24, 12 were cases of infection with a bacterium known as *Corynebacterium pyogenes*. Apart from causing pneumonia in calves, this organism is responsible for other disorders in livestock such as summer mastitis in cows and heifers and abscess formation in cattle, pigs and sheep. *C. pyogenes* has been recognized, since the latter part of last century, as being associated with these conditions; it was not known, however, till lately, how it entered the body or, when there, how it produced disease.

These questions have been studied during the current year and the results of the investigation have a bearing on the possibility of prevention in practice. Altogether 45 strains of *C. pyogenes*

have been studied in different ways, but it was found impossible to distinguish between strains isolated from pigs on the one hand and from sheep and cattle on the other. One important fact, however, was discovered, namely that the organism, when cultivated in the laboratory in a particular manner, produces a toxin or poison which is capable of killing laboratory animals such as mice or rabbits. Furthermore, it has been found that this toxin will dissolve the red blood corpuscles of animals, and that this solvent action is a convenient measure of its strength.

Toxin production by *C. pyogenes* is a new observation, and it is as yet impossible to assess its importance. It is not yet known whether, or how far, the effect of the microbe on the animal is due to the production of toxin. If the toxin should be found to play an important part in the production of disease, then future research on the protection of animals will have to be based on the fact.

That the strength of the toxin can be tested by its power to dissolve the red blood cells is fortunate from the point of view of the investigator, for such a test can be carried out in a test-tube; some toxins, for instance that of lock-jaw, can be tested only by the inoculation of laboratory animals, which is a tedious and expensive method. Moreover, a method is now being developed at the Institute whereby the toxin can be pitted against the neutralising substance (anti-toxin). which can be found in various degrees of strength in the bloods of animals. Research is therefore now being directed to the development of methods of studying the *C. pyogenes* anti-toxin content of the blood of animals. If large enough numbers of blood samples are examined, the samples being taken from different species, from individuals of both sexes and from animals of different ages, it should be possible to develop methods of detecting infected animals, and also to estimate the prevalence of *C. pyogenes* infection in a particular herd or area.

COMPARISON OF ELECTRICAL POWER WITH TRACTOR AND ENGINE POWER FOR FARM MACHINERY.

Rothamsted Experimental Station.

The following are reports of the tests carried out during the year :—

(*a*) *Grinding, &c.*

A 20 H.P. Electric Motor was compared with a 10–20 International Tractor for driving a combined grist and rolling mill

engaged in four separate operations. The results, in terms of output per hour and of current or fuel consumption, were as follows :—

—	20 h.p. Electric Motor		10–20 International Tractor	
	Output per hour. Cwt.	Current Consumption per hour. Units.	Output per hour. Cwt.	Paraffin Consumption per hour. Gallons.
Grinding barley	7·4	6·8	7·75	1·05
Rolling oats	5·45	5·05	5·20	0·86
Rolling wheat	11·6	5·03	9·75	0·89
Grinding kibbled maize ..	6·9	4·85	6·55	0·855

The quantity of paraffin, in gallons, which was equivalent to 10 units of electricity in each of the above tests is given below. Since the quantities of material passing through the mill were not exactly the same for the motor and the tractor, the results are expressed both in terms of time and of output :—

GALLONS OF PARAFFIN EQUIVALENT TO 10 UNITS OF ELECTRICITY.

	Per Unit Output.	*Per Unit Time.*
Grinding Barley	1·48	1·54
Rolling oats	1·78	1·70
Rolling wheat	2·05	1·76
Grinding kibbled maize	1·84	1·76
Means	1·79	1·69

It may thus be said that about a gallon and three-quarters of paraffin was required to do the same work, with the equipment in question, as ten units of electric current.

(*b*) *Threshing.*

Threshing tests were carried out in 1933, 1934 and 1935 in order to compare, as sources of power, a 20 H.P. electric motor, a new tractor and an old tractor. The 1938 crops will be available for further tests, but these had not been begun at the date of preparing this report.

The readings taken in 1933 are of no value for comparative purposes, since the internal wiring of the motor was faulty, and it was not possible to correct the readings taken.

The experimental results for the 1934 and 1935 crops were as follows :—

Electric Motor.

—	Crop.	Thresher Speed.	kW.		h.p. at 85 % efficiency.
1934	Oats	1066	7·5		8·55
	Wheat	1068	7·7	7·6	8·8
	Barley	1078	7·15		8·15
	Wheat	1080	7·95		9·05
	Barley	1204	8·45		9·65
	Oats	1204	7·85		8·95
	Barley	1206	9·17		10·45
				8·3	
1935	Oats	1198	8·1		9·25
	Oats	1200	8·1		9·25
	Wheat	1140	8·3		9·45

Ignoring differences between crops, the average power required was 7·6 kW. for the lower speed and 8·3 kW for the higher. In only one experiment was the power developed by the motor greater than 10 H.P.

New Tractor.

—	Crop.	Tractor Speed.	Thresher Speed.	Paraffin per hour.	
1934	Wheat	703	1067	1·30	—1·35
	Oats	706	1074	1·41	
	Barley	653	1151	1·45	—1·34
	Barley	645	1154	1·23	
	Oats	706	1206	1·52	—1·48
	Wheat	—	1203	1·43	
1935	Oats	597	1080	1·34	
	Oats	605	1064	1·80	
	Oats	622	1064	1·80	
	Wheat	623	1103	1·27	

Ignoring the two measurements of 1·80 gallons (when the carburettor was left at its field setting) the mean consumption for the eight measurements was 1·37 gallons.

Old Tractor.

—	Crop.	Tractor Speed.	Thresher Speed.	Paraffin per hour.
1934	Wheat	585	1064	1·18
	Barley	637	1128	1·39
	Barley	639	1134	1·37
1935	Oats	611	1056	1·50

Mean 1·36 gallons.

For all experiments with the motor the mean consumption was 8·0 units per hour: thus 10 units were equivalent to 1·7 gallons of paraffin. As both power sources were working at less than half their rated loads, this comparison is probably more unfavourable to the internal-combustion engine than would have been the case had smaller power units been employed and more fully loaded.

(c) *Cake Breaking.*

Measurements of current consumption were made with a 2-H.P. fixed hoist and cake breaker. The results were as follows:—

——	Output per hour. Cwt.	Consumption per ton. Units.	kW.
Linseed cake	8·75	·77	·34
	12·0	·68	·41
	12·1	·64	·39
Cotton cake	9·6	·82	·39
	18·5	·53	·49
	20·0	·57	·57

The power consumption was too small to be measured accurately by direct reading of the meter.

(d) *Measurements of Electric Current Consumption with a 20-H.P. Electric Motor Driving a 10-H.P. Fixed Grinding Mill.*

The routine measurements on the grinding of barley gave consumptions, per ton of output, varying from 9·9 to 27·8 kWh.

An examination of the possible causes of error showed that the technique was capable of sufficient accuracy, and suggested that the factors having the greatest influence on the power consumption were the fineness of the product and the rate of grinding. A failure of the lubricating system to the mill shaft may have caused the high values in the routine records.

Grinding experiments at different feeding rates, and with the mill set to produce meals of varying fineness, demonstrated the wide range of electricity consumption obtainable by altering these factors.

(e) *Comparison of 5-H.P. Electric Motor with a 6-H.P. Vertical Diesel Engine.*

These two sources of power were used to drive a Bamford combined grist mill, and were compared on barley grinding.

Owing to the impossibility of setting the mill to give a definite degree of fineness at a given grinding rate, the two power units could be compared only in a very indirect fashion. For each of a series of grinding rates, the power necessary for differing degrees of fineness was measured. Comparing the fuel and electricity consumption for the same fineness (determined by sieving) and the same grinding rate, some idea of the comparative performances could be obtained.

Over a power-output range of 4·5 to 5·3 H.P., the diesel oil consumption was 0·46 pints (or 0·49 lb.) per B.H.P. hour. For these measurements the diesel oil equivalent to 10 units of electricity is 5·0 pints.

Some further measurements were made with the Drumotor and a Bamford mill, rolling oats, but no comparisons were made with the diesel as the source of power. The range of the results was :—

3 to 15 cwt. per hour.
2·34 to 3·55 units per hour.
15·3 to 4·7 units per ton of output.

(*f*) *Potato Sorting.*

A comparison of a ½-H.P. electric motor with hand labour was made on the work of driving a potato sorter.

Routine reading on the farm (obtained by direct reading of the meter) gave the following figures :—

> 10 cwt. potatoes sorted in 31 minutes; consumption 0·4 units; output per hour 19·4 cwt.; electricity consumption per ton of output 0·8 units.

At full load, efficiency 68 per cent., the power consumption by the motor should be ·55 kW. The above reading thus corresponds to an overload of nearly 50 per cent., demonstrating the uselessness of direct reading of the meter for small jobs.

A series of tests, in which the current consumption was measured by timing the revolutions of the meter disc, gave consumptions varying from 0·27 to 0·16 units per ton for sorting rates within a range of 25 to 37 cwt. per hour. The power varied from 0·30 to 0·34 kW, indicating that the motor was working at about half load.

Costs.

Calculations of overhead and total costs have been made for the threshing and grinding measurements (1) for Rothamsted, (2) for commercial conditions.

NODULE BACTERIA OF LEGUMINOUS PLANTS.

Bacteriology Department, Rothamsted.

Work was continued on the problem of " good " and " poor " strains of nodule bacteria. This work falls under two headings :—(1) a search for the causes which make the poor strains ineffective in fixing nitrogen, and (2) a study of competition between good and poor strains for nodule production.

(1) *The Nature of Ineffective Nodules.*

The search for the causes of inefficiency in poor strains was begun by comparing the structure and cytology of nodules produced by " good " and " poor " strains, and also the growth and metabolism of such strains on artificial media. For these purposes it has been necessary to compare a number of such strains from, and in, different host plants; individual strains show many differences, most of which are not correlated with efficiency in nitrogen fixation and which are, consequently, of little interest in this connection. Indeed none of the growth characters as developed on artificial media has so far been found to be correlated with efficiency, a fact suggesting that this efficiency has some close connection with the reaction of the host plant to the bacterium. In fact a study of the anatomy of nodules from clover, pea and soybean, infected with good and poor strains, has shown three types of difference constantly correlated with effectiveness. (1) " Good " strain nodules have a persistent meristem cap, whose activity causes growth of the nodule. In " poor " strains this cap disappears early in the development of the nodule. (2) In " poor " nodules, the bacteria make an early attack on the inter-cellular spaces of the nodule and soon destroy the internal tissues. This parasitism may well be causally connected with the early disappearance of the meristem cap. (3) In " good " nodules a pink pigment, probably a quinone derivative, is visible when the fresh nodule is cut open. This has never been found in " poor " nodules. The nature and functions of this substance are now under investigation.

(2) *Competition Between Strains.*

As mentioned in last year's report, it has been found that the competition for nodule formation can largely be accounted for by the active repression of the growth of one strain by another in the surroundings of the root system. Attempts have been made to change the course of this competition by various additions to the soil, but so far without success. The course of competition depends on the relative growth rates of the strains; the

problem therefore is to find a substance which can be added to the soil and which will differentially affect the growth rates of good and poor strains.

There is also the possibility that an acquired immunity, on the part of the host plant, may act in favour of one strain as against another. It has been found that a plant already bearing nodules is to some extent immune to increased infection, but it does not seem that this immunity is greater towards a different strain than towards the same strain. It seems, therefore, that competition between strains occurs outside and not within the host plant.

(3) *Loss of Nodule-Producing Ability.*

Certain strains during artificial culture in the laboratory have lost the power to infect the host plant (clover). All the strains of nodule bacteria tested have been found to secrete a growth-promoting substance. The production of this substance is appreciably less in the case of strains which have lost the power to form nodules, and hence the substance in question is likely to be concerned with nodule production. A further investigation of this question may throw a new light on the specially beneficial effects of farmyard manure on legumes, for growth-promoting compounds are known to occur in urine.

GRAZING TRIAL ON THE MANURIAL RESIDUES OF CAKE.

ROTHAMSTED FARM.

The 1938 grazing season was the first in which experimental treatments were given in this trial. The preliminary work, carried out in 1937, consisted in measuring the irregularities of the land and in improving the experimental technique.

The experimental design is three blocks, each of three plots. When the experiment is fully established one of the three blocks will be grazed by bullocks alone. On one of the three plots constituting this block the cattle will receive cake. A second plot will receive, in the following winter and spring, a dressing of fertilizers calculated to supply the equivalent of the residual manurial value of the cake. The third plot will receive neither cake nor fertilizer. In the two succeeding years the residual effects of the cake, and the effects of the fertilizer, will be measured by means of the live-weight increases of grazing cattle and sheep. It will be clear that if this cycle were to be adopted from the outset, one of the three blocks would receive no treatment until the third year of the trial. In order to avoid this delay, a temporary modification has been arranged; treatment was applied to two of the three blocks in 1938 and these two will be run in parallel

during the 1939 season. The normal cycle will be adopted in 1940. One of the blocks will thus, in the first cycle, give no information about the second-year manurial residues; on the other hand, replicated plots will give, in 1939, information on the effects of the residues in the first year after treatment. A similar device has been used, in the past, at the commencement of long-term rotational experiments.

In March 1938, before grazing began, all plots were chain-harrowed both ways. Cages were placed in position in order to obtain samples of the ungrazed herbage for botanical analysis. There were four cages for each half plot.

The grazing stock used in 1938 consisted of well-conditioned Blue-Grey bullocks (Shorthorn-Galloway crosses) on the plots receiving cake (Nos. 2 and 4), and of Blue-Grey heifers on the other plots. Blocks I and II were grazed with cattle alone, while Block III was stocked with cattle and sheep in the ratio of three sheep to one beast. The sheep were half-bred (Border Leicester-Cheviot cross) ewe hoggs.

Grazing commenced in April 29th with six cattle on each plot and 18 sheep, in addition, on each plot of Block III. Weighings were done fortnightly. On June 9th, after the routine weighing, some of the stock was removed from certain plots owing to the poor growth of grass. A week later, on June 16th, all the stock was weighed off the plots.

During the first period, cake was fed to the bullocks on plots 2 and 4 at the rate of 6 lb. per head per day. The mixture consisted of 50 per cent. flaked maize and 50 per cent. undecorticated cotton cake, and the total amount fed per plot was 1,656 lb. Samples of the constituents of the ration were taken, at each mixing, for chemical analysis.

On August 16th the cattle and sheep were weighed back on to the plots. During this second grazing period cake was fed at the rate of 10 lb. per head per day for the first two weeks and was then increased to 12 lb. The mixture consisted of 50 per cent. flaked maize and 50 per cent. decorticated groundnut cake, and the total quantity fed was 3,300 lb. per plot. The number of animals per plot varied, during this second period, according to the amount of grass available, the aim being to keep all plots grazed down to the same level. On October 4th all stock was removed, the grass having been grazed down bare.

During the time between the two grazing periods samples of the ungrazed herbage were taken from the cages for botanical analysis.

The severe and prolonged drought during the spring and summer greatly restricted the growth of grass. There was no

real flush of grass in the spring, and very little growth during the summer. None of the plots was topped, as the stock kept the grass and the flowering culms grazed down tight.

The number of grazing days for each plot, and the live-weight increases of the stock, are given in the following table :—

Plot Number.	Grazing days.		Total live-weight increase (lb.).		Average increase per head (lb.)	
	Cattle.	Sheep.	Cattle.	Sheep.	Cattle (per day).	Sheep (per week).
1	456	—	785	—	1·721	—
2*	582	—	1433	—	2·462	—
3	498	—	817	—	1·640	—
4*	582	—	1317	—	2·263	—
5	519	—	1032	—	1·988	—
6	519	—	1093	—	2·106	—
7	435	1323	737	614	1·694	3·239
8	435	1323	642	567	1·476	2·991
9	435	1323	716	557	1·646	2·938

* Plots receiving cake:
Cake fed per plot .. .. 1st Period 1656 lb.
2nd period 3300 lb.

The larger numbers of grazing days on plots 2 and 4, on which cake was fed, entailed leaving the cattle on these plots longer than the growth of grass warranted; the object was to get the amount of cake fed closer to the amount that would be fed in a year with a normal growth of grass. This overstocking probably accounts for the small live-weight increases of the bullocks receiving the cake.

TRIALS OF GRASS SEEDS MIXTURES.

WELSH PLANT BREEDING STATION, ABERYSTWITH.

Trials were laid out in 1937 at twenty-three different centres in nine English counties. In 1938 a further seven centres in six counties have been started. There are now, therefore, twenty-nine trial centres situated in thirteen counties in England. These are Yorkshire, Lancashire, Derby, Shropshire, Worcester, Gloucester, Hereford, Somerset, Wiltshire, Warwickshire, Cheshire, Middlesex and Sussex.

The plots have been laid down under a wide range of conditions, including differential manuring and management, and are, of course, on a considerable range of soil types. At most centres the lay-out is a simple one, consisting of an experimental mixture of pedigree (Station bred) seeds with a smaller plot of commercial seeds on a part of the field. At a few centres there are some six or more plots, each sown with special mixtures of

pedigree strains and designed to test leafy ryegrass, leafy cocksfoot and leafy timothy when sown as the chief components in seeds mixtures.

In some cases, as in Wiltshire, the County Agricultural Organizer has superimposed a simple manurial trial on the new ley. Such modifications are always of interest and may well provide data of considerable value.

Results.

Of the total of twenty-nine trials laid out in the two years 1937–38, twenty-five centres have been visited during 1938, and notes have been made on them. Taken as a whole the trials have created a considerable amount of local interest and, in the main, it may be said that swards have been successfully established.

Possibly the most remarkable feature, particularly at centres started in 1938, with its intense spring drought, is the successful establishment of seeds even in the face of the drought. This is, in particular, true where the seeds mixture has been sown without a cereal nurse crop. One trial centre in Middlesex may be quoted as an example. Here the seeds were sown on March 10th, 1938, direct on the upturned sod of an old bent sward, to which lime and basic slag had been applied. Up to mid-September this field had had practically no rain since it was sown and had been stocked with sheep from the outset. The establishment of seeds had been incredibly good and, according to the farmer (Mr. Aughton, of South Barvin Farm, Enfield Chase), the 4-acre plot of new seeds, situated as it is in a 30-acre field and wholly unfenced from the remainder of the field, has given more feed during the summer of 1938 than the remaining 26 acres.

Similar experiences are to be related for other centres sown without the cereal nurse crop, and there can be little doubt that in years of drought, as well as in years of excessive rainfall, the advantages to be gained by sowing seeds without a cereal nurse was very great. In dry years the cereal hampers the grass by starving it of moisture, while in wet years the corn crop is either laid or is so heavy that the young seeds are crowded out.

In the trial plots sown in 1937, and where hay was taken in 1938, the general experience has been that, where the hay was cut early (earlier than mid-June), the crop was light and the advantage in yield at the time was with the commercial strains, although the pedigree strains were the more leafy. Where, however, the hay crop was not cut until July, the crop was heavy and the advantage definitely lay with the pedigree strains.

This was largely due to the heavier (but later) crop given by Montgomery red clover as compared with the early flowering varieties of red clover.

In early summer (June, 1938) the most disappointing centres were those on the thin soils of the open Downs in Wiltshire. Two of these were sown in 1937 and one was reploughed and resown in 1938. The growth at these two centres was small, but it is quite likely that they will have improved after the late summer and autumn rains of 1938. It will be interesting to follow the later history of the swards at these centres.

It is hoped to set up a considerable number of further trials during the spring and early summer of 1939. From the evidence which has already been obtained, and from the general interest which these trials have aroused, it will obviously be important that the numerous trial centres shall again be examined during 1939 and in subsequent years. It will be remembered that one of the original objects of the trials was to test pedigree strains for long-duration leys.

The following is a list of the centres where trials have been established :—

List of Centres.

(The Year of Sowing is Shown in Brackets.)

Cheshire.

A. Yearsley, Pool Farm, Whitegate, Northwich (1937).
Cheshire School of Agriculture, Reaseheath, Nantwich (1937) (1938).
Mr. Lomas, Sutton Hall, Sutton Weaver, Nr. Warrington (1937).

Derbyshire.

Col. Vaughan Williams, Brocksford Farms, Doveridge, Derbyshire (1938)

Gloucestershire.

G. L. Snell, The Elms, Bromsberrow, Nr. Ledbury (1937).
W. H. Blake, Upper Slaughter, Bourton-on-the-Water, Cheltenham (1937).
N. E. B. Elgar (Agent to Lord Dulverton), The Estate Office, Batsford, Moreton-in-Marsh (1938).

Herefordshire.

J. Griffiths, Small Ash, Sutton (1937).
Mr. Tidmarsh (Manager), Hagley Court, Hereford (1937).

Lancashire.

R. L. Muirhead, Borsdane Farm, Westhoughton, Lancs. (1937).
Lancashire County Council Farm, Hutton, Nr. Preston (1937).
T. C. Shepherd, Aston Grange, Preston Brook, Warrington (1938).

MIDDLESEX.

G. Aughton, South Barvin Farm, Enfield Chase, The Ridgway, Enfield (1937).
J. P. James, 10, Field Road, Denham, Uxbridge (1937).
Messrs. Field Bros., Whiteheath Farm, Harefield (1937) (1938).

SHROPSHIRE.

T. W. Lea, Rodington House, Rodington, Shrewsbury (1937).
T. Jones, Rectory Farm, Lydham, Salop (1937).

SOMERSET.

W. King, Sandhill, Washford (1937).
Messrs. F. Thomas and Son, Rodhuish, Washford (1937).
T. G. Merchant, Tuxwell, Spaxton, Bridgwater (1937).

SUSSEX.

Rt. Hon. The Earl de La Warr, P.C. (H. J. Pusey, Manager), Buckhurst Estate Office, Withyham (1938).

WARWICKSHIRE.

Clyde Higgs, Hatton Rock, Stratford-on-Avon (1938).

WILTSHIRE.

E. J. Snook, Rookery Farm, Urchfont, Devizes (1937).
J. Houghton Brown, Hill Devrill, Warminster (1938).
G. H. Barnes, Maddington Farm, Shrewton (1937).
G. W. N. Coles, Berwick Farms, Fonthill Bishop (1937).

WORCESTERSHIRE.

T. Nellist Wilks, Whartons Park, Bewdley (1937).
Capt. R. H. Stallard, Throckmorton Court, Pershore (1937).

YORKSHIRE.

W. J. Lister, Fleensop, Middleham, Yorks (1938).
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THE CONTROL OF SHEEP TICK.

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KING'S COLLEGE, NEWCASTLE-ON-TYNE.

I. *Protection of Sheep from Ticks.*

Destruction of ticks by dipping sheep is one of the most important lines of defence against all tick-borne diseases. Earlier work has shown that certain arsenical dips are very effective in this respect, and also act as repellents against subsequent reinfestation. In 1937 it was reported from Aberdeenshire that dips made with derris root were valuable in these respects, and on account of the obvious advantages which these dips possess (*e.g.*, their cheapness and the fact that they are non-poisonous to sheep but act as contact poisons to ticks,

keds, &c.) it was decided to test a number of variously compounded derris dips. The technical problems were dealt with by the Cooper Technical Bureau, and Dr. MacLeod, of the Bureau staff, co-operated actively in this part of the work, which may be sub-divided into the following parts :—

A. *Ewes.*—The following five experimental dips were used on five groups of sheep grazing on tick-infested pastures where, for years, the lamb mortality from tick-associated diseases has been high.

Dip A (Arsenic-carbolic paste).
Dip B (Derris-carbolic-woolfat paste).
Dip C (" Highland " Tick Paste).
Dip D (Derris-carbolic paste).
Dip E (Solution of derris extracts).

The ewes in all five groups were dipped with the above dips a day or two before lambing was due to commence, and thereafter at three-weekly intervals throughout the tick season. Twenty hogs were retained in each group as undipped controls, and comparative tick-counts were conducted every week as required. The results were as follow:—

Average Tick Counts (adult females)
(10 dipped and 10 undipped sheep).

All groups dipped 13th and 14th April.

Dips.	21 April.		28 April.		5 May.	
	Dipped.	Controls.	Dipped.	Controls.	Dipped.	Controls.
A	5·5	29	31	37	15	16
B	23	26	65	40	—	—
C	4	30	23	50	18	14
D	39	52	75	73	—	—
E	21	35	50	54	17	8

These figures show that none of the dips compounded with derris possessed much, if indeed any, tick-deterrent properties. It is known that these dips are efficient tick-killing agents but, under the conditions of this test, they showed no value as repellents. Consequently, at the second dipping on 5th May, Dips B and D were discarded, and Dips A and C substituted in these groups. Dip A showed only moderate protection, which faded between 1 and 2 weeks after immersion. The most satisfactory dip was Dip C which showed, as was the case in 1937, a marked deterrent effect two weeks after use.

B. *Lambs.*—Experience has shown that, on most farms, it is impracticable to collect and dip young lambs earlier than three weeks after the date on which lambing commenced. The difficulty is not the risk of injury to the lambs, but that earlier dipping seriously interferes with farm economy at a time when shepherds are busiest. Lambs, however, become tick-infested soon after birth and, as a result, pyæmia infections are often introduced at an early age. For this reason it was necessary to consider how young lambs could best be protected from ticks until it should be found convenient to dip them. The following tests were planned :—

(1) In a group of sheep with an anticipated lamb crop of 100 per cent. the fleeces of half the lambs were dusted with a powdered preparation of ground derris root, as soon as possible after birth. Each alternate lamb born remained untreated to serve as a control.

A comparative tick count was made on 6th May, when ten lambs from each group were examined. Only the oldest lambs were counted and their ages were estimated at between 12 and 17 days.

Dusted lambs ..	0, 0, 0, 3, 3, 6, 0, 0, 3, 0.	.. Average 1·5.
Untreated lambs ..	12, 14, 13, 14, 6, 10, 15, 8, 14, 22.	.. Average 12·8.

The dusted lambs looked healthier, and the derris dust had produced no harmful effect on the skin or fleece. In the dusted group the skin was smooth and healthy, but in the control lambs the skin was rough, with numerous papillæ marking sites where engorged ticks had already fallen off.

All except six of the control lambs were dusted on 6th May and a comparative count was made on 20th May.

Dusted lambs ..	2, 7, 7, 6, 4, 0, 1, 4, 5, 3. ..	.. Average 4·0.
Untreated lambs ..	23, 6, 10, 24, 16, 12. ..	.. Average 15·0.

A similar result was obtained in another group of lambs which were dusted on 5th May. A comparative count was made on 22nd May.

Dusted lambs ..	0, 4, 3, 3, 8, 13, 5, 4, 6, 8, 3.	.. Average 5.
Untreated lambs ..	13, 21, 17, 13, 17, 17, 18, 23, 8, 10, 8.	.. Average 15.

(2) In another group of sheep with an anticipated lamb crop of 150 per cent. the dusting of newly-born lambs was compared with immersion of lambs in a dilute water infusion of derris. Alternate lambs were to be treated by these methods to ensure a comparative test.

Unfortunately the shepherds themselves decided against immersion and in favour of dusting, and it was not possible to persuade them to continue this test after one week. (It will

be appreciated that lambs had often to be carried some distance in order to immerse them. Not only was this troublesome, but shepherds are disinclined, on general grounds, to interfere with a ewe and a lamb at this time.) One comparative count was however made on May 9th.

Dusted lambs ..	0,	2,	0,	2,	0,	1,	1,	0,	3,	1.	.. .. Average 1·0.
Immersed lambs ..	3,	5,	5,	4,	5,	2,	3,	2,	4,	7.	.. .. Average 4·0

The only conclusion that can be drawn from this test is that the immersion method of treating lambs is impracticable on hill farms. It is worthy of trial on lowland farms.

(3) In another group of lambs it was decided to test the tick-deterrent value of an oily smear containing derris root applied to young lambs soon after birth. Ten control lambs remained untreated. A comparative count was made on 8th June. The results were :—

Smeared lambs	Average 2·0
Untreated lambs	„ 6·8.

On 11th July all the lambs in this group were inspected, and the numbers of each group were weighed. The individual and group average live-weights were :—

Smeared.	*Untreated.*
33 lb.	21 lb.
38	25
39	16
26	21
29	24
29	23
35	28
41	31
29	
29	189
30	
40	
31	
42	
471	
Average 33·6 lb.	Average 23·5 lb.

The average live-weights thus show a difference of 10 lb. in favour of the smeared lambs. Two control lambs had died from pyæmic infections and two were lame. In general, the smeared lambs looked much healthier and none were lame.

Of the three methods tried, the best results were obtained by dusting the newly-born lambs with a powdered preparation of derris root. All these methods were tried on lambs on another tick-infested farm, but as no controls were left, each method

being compared with the other two. Here again, comparative counts showed slightly in favour of the dusting method. On this farm the shepherds reported a little trouble from mis-mothering following the use of both the derris powder and derris smear. This trouble was not serious and was not reported elsewhere.

On the farm where this test was conducted the lamb mortality was reduced in 1938 to one-quarter of that experienced in previous years.

II. *Tick-borne Fever.*

MacLeod has stated (*Parasitology*, Col. 28, July, 1936), "If ticks are present on sheep in appreciable numbers, if there is a high general mortality among the stock, death being due apparently to a variety of disease factors, and specially if the lambs exhibit a general falling off in health and condition when a few weeks old, the period of ill-health lasting from 2–3 weeks, then it is a reasonably safe assumption that tick-borne fever is actively present, and is exacting its toll of health and life."

There are many farms in Northumberland and Cumberland where the above description of ill-health among sheep, and in particular of lambs, applies with almost perfect accuracy, with the exception that it has not been possible in the past definitely to diagnose tick-borne fever in a single case. MacLeod seems to imply that tick-borne fever exists as a primary infection in most tick-infested lambs, and that this predisposes to a number of secondary infections; among these no doubt pyæmia is included, although not actually mentioned. In Northumberland the ill-health and deaths among the stock have been noted to be due, not to a variety of disease factors, but principally to pyæmia; this disease, it is admitted, manifests itself in a variety of different ways depending upon the particular organs affected. It therefore seemed important to enquire more closely into the pathogenesis of pyæmia, and discover what connection, if any, might exist between tick-borne fever and pyæmia.

For this purpose a record was made of the body temperatures of young lambs born on tick-infested grazings. (Fifty lambs died from ascertained pyæmia on this farm in 1937.) Two groups, each of 50 lambs between the age of 1 and 2 weeks, were temperature-recorded every second day for four weeks. A temperature of 105·8° F. was taken as the normal limit, and blood smears were taken from all lambs showing a higher temperature. These were stained with Giemsa and examined later. A total of 22 lambs either lost their number tags or were for various reasons not regularly examined; the results below refer only to the other 78 lambs.

Of the 78 lambs whose temperatures were recorded regularly for four weeks during the tick season 52, or about two-thirds, evinced at one time or another a temperature higher than 105·8° F. In the other 26 lambs, about one-third of the total, the temperatures remained below this figure.

About 150 blood smears were taken from the above 52 lambs and, in the case of 16 lambs, the smears showed inclusion bodies in neutrophile cells. It is impossible to say that these bodies were in any of the cases identical with the bodies thought to be characteristic of tick-borne fever, but in seven smears the appearance was highly suggestive. It is regretted that it was not possible to carry out sub-inoculations into healthy sheep, as this would probably have settled the question. Two of these temperature-recorded lambs died from pyæmia, and one of these showed a high temperature for a week before death.

In all about 30 cultures were isolated from lambs dead from pyæmia. The micro-organisms obtained appeared in all cases to be staphylococci.

THE CUMULATIVE EFFECTS ON A LIGHT ARABLE SOIL OF VARIOUS METHODS FOR THE DISPOSAL OF BEET TOPS AND STRAW.

Norfolk Agricultural Station.

The series of four rotational experiments designed to investigate the effects of various methods of disposing sugar-beet tops and straw has been continued during the past year. Three of the experiments were laid down in 1936 and these require one more crop to complete a four-course rotation of sugar beet, barley, seeds, wheat; the fourth experiment, laid down in 1937, has completed half the rotation.

The weather conditions during the past year have been very different from those of the previous two years, particularly in regard to the rainfall. In 1938 the rainfall during the first six months amounted to less than seven inches, compared with sixteen inches and nearly eleven inches for 1937 and 1936 respectively.

Possibly as a result of the low rainfall, the yield increases following sheeping were considerably greater in 1938 than 1937.

This year the sheeping of beet tops as a preparation for barley gave almost the same yield as beet tops ploughed in, whereas last year sheeping gave a considerably lower yield than ploughing in; the probable explanation is that the high rainfall of 1937 removed the more soluble residues of the sheep fold. The effect of sheeping the 1937 seeds crop, as opposed to carting

it off as hay, resulted in a significant increase in the yield of wheat in 1938, whereas in the previous year, no differences were observed.

The different methods of disposal of straw have given results resembling those for 1937, except that the effect of ploughing in straw for sugar beet, either as farmyard manure or in the unrotted condition, was more marked in the following barley crop than it was in 1937.

The two years' results indicate how the effects of the different treatments may depend, among other things, upon the weather, and illustrate the importance of obtaining figures over a period of years before drawing any definite conclusions.

During the past year a new rotational trial has been laid down to investigate the increases in yield that follow the application of straw with its complement of sulphate of ammonia; the question which the trial is designed to answer is how far these are due to the nitrogen applied in the fertiliser and how far to the straw. The first crop is sugar beet, and this will be followed by barley, seeds and wheat to complete the rotation. As it is expected that the effects of the different treatments will be spread over several years, it would be of little use to discuss the results after only one year of trial.

THE FARMER'S GUIDE TO AGRICULTURAL RESEARCH IN 1937.

For the past thirteen years the Royal Agricultural Society of England has issued annual summaries of Agricultural Research, as carried on in its leading branches, prepared under the direction of the Research Committee of the Society. The publication, originally issued under the title of *Agricultural Research*, is now known as *The Farmer's Guide to Agricultural Research*, for this describes the main purpose with which the Society undertook the work, namely, to spread the lessons of research among those to whom they are likely to be of greatest use by giving the farmer information on the results of the year's work of the experimental stations in a summarized and simple form.

The survey of scientific work which it provides is not limited to research conducted in the British Isles, but includes references to the results achieved in any part of the world from which light may be thrown on the problems of British agriculture.

As last year, *The Farmer's Guide* forms a section of the Society's *Journal* so that it may be in the hands of every member of the Society. At the same time a number of copies are being bound separately for distribution to the Press and to centres of Agricultural Education and Research.

Dr. Charles Crowther has found himself unable to continue as author of the section on the Feeding of Live Stock, and Dr. H. E. Woodman, of Cambridge, takes his place. This year there is an addition to the usual list of reviews, *viz.*, a section on *Pests and Parasites*, by Mr. J. C. F. Fryer and Dr. H. W. Miles.

A few copies of previous issues are still available.

CROPS AND PLANT BREEDING.

I.—GRASSLAND.

General.

The Fourth International Grassland Congress was held at Aberystwyth in 1937, and a full report of the proceedings has been published in one volume (Ref. 1). It is impossible to review all the subjects dealt with, but brief reference must be made to those papers and discussions which come within the usual scope of this review.

Many speakers referred to the great importance of regionalised breeding in herbage plants, and Stapledon (Ref. 2) in his presidential address defined the position clearly by saying that "plant breeding to be of maximum benefit should be conducted in the region it is proposed to serve." This idea is undoubtedly the key to all work on the development of improved strains of herbage plants, and is the logical consequence of the conception of indigenous strains. It does not follow that no useful purpose is served by the exchange of breeding material between countries, but if the full value of such exchange is to be realised it must include indigenous as well as commercial strains.

The second important matter of discussion, for our present purpose, was the importance of correct management in the establishment and maintenance of good grassland. Stapledon stated that controlled grazing, and the establishment and maintenance of conditions suitable to the growth of a leguminous plant such as white clover, are the essential features of good grassland farming. But enlightened management should aim higher than this and the third important point is the maintenance of a constant supply of young and rapidly growing herbage, particularly at those times of the year when it is most urgently needed, *i.e.*, "out-of-season" grass. These problems are largely capable of solution by management, particularly by rotational grazing of the farm as a whole and of individual fields, due care being taken to avoid a repetition of the same management to a given field year after year. Stapledon maintains that it is just as necessary to vary the treatment of a permanent pasture from year to year as to vary that of a temporary ley. In both cases the botanical composition is greatly influenced by the times of year at which heavy grazing and resting are practised, while the application of nitrogenous manures at the same time each year generally accentuates the effect of a given grazing programme.

The production of short grass throughout the year can be effected either by the proper choice of species and strains in mixtures for temporary leys, or by controlled grazing, resting and manuring of each of the particular fields. Experiments at Aberystwyth have demonstrated that simple mixtures of the Station's strains of timothy and meadow fescue, combined with wild white clover, give a high yield of herbage throughout the normal growing season, while Station strains of meadow foxtail and red fescue, again with wild white clover, give a sward which is remarkably winter-green, and yields well in late February and March. Again, by suitable management—grazing up to the middle of August or into September, with the application of one hundredweight per acre of nitro-chalk—it has been possible to obtain good herbage from Christmas to the end of March on swards sown down to winter-green strains.

The production of winter grass is discussed further in Refs. 3, 4 and 5. Stapledon (Ref. 3) describes the use of pure species and strains such as Italian ryegrass and Aberystwyth timothy (sown in drills) for this purpose. A successful mixture included Italian ryegrass, and indigenous strains of perennial ryegrass, cocksfoot, meadow foxtail and red fescue, combined with wild white clover. In such a mixture Italian ryegrass is the only nurse crop, and good grazing is obtained in July and August of the seeding year. In New Zealand calcium and phosphorus are advocated as initial dressings for winter grass, followed by application of nitrogen (Ref. 4). If sufficient clover is present, the grass may be stimulated sufficiently by the clover nitrogen, but the clover itself must first be stimulated with superphosphate. In this account, stress is laid on the importance of previous management, and especially on the early putting up of fields intended for the production of winter grass. In Reference 5, a short account is given of one-year mixtures composed of crimson clover, hairy vetch (*Vicia villosa*) and Italian ryegrass (or winter wheat or rye for drier conditions) for the production of winter grass in Hungary and other parts of the Continent.

Breeding and Seed Production.

Two articles in the 1937 United States Department of Agriculture Yearbook (Ref. 6), are of special interest to those concerned with the breeding of grasses. Before considering these articles it is worth mentioning that the Yearbook as a whole contains valuable information on breeding work in vegetables, flowers, leguminous crops, fruits, nuts and forest trees in addition to that on certain grasses. Each article is a review of the present position and of current problems, and includes a good bibliography, thus making the Yearbook a most valuable compilation.

The first of the articles mentioned above is an account of the breeding of miscellaneous grasses, and includes a brief description of the geographical grassland areas of the world with the important economic genera and species occurring in each (Ref. 7). The second article is devoted to the improvement of timothy (Ref. 8). The authors of Reference 7 stress the importance of breeding herbage plants adapted to local conditions. To this end a knowledge of the characteristic climatic demands of each species is essential. The general position in grass breeding at present seems to be that workers are still primarily concerned with the selection of improved strains within mixed populations, although hybridisation is also, of course, being practised. It is therefore very important to realise that self-fertile forms have now been found in cocksfoot, perennial ryegrass, Italian ryegrass, tall fescue, meadow fescue, smooth-stalked meadow grass and other species. If desirable self-fertile forms can be isolated

in these species, which are normally more or less self-sterile, it will greatly simplify the technique of breeding. This question will be considered in a later section of this article.

Many herbage plant breeders are strongly emphasising the use of forms native to a particular district as the principal breeding material for the locality in question. Sylvén (Ref. 9), refers to the importance of natural selection, acting on the mixed populations known as wild species, in the production of types from which desirable economic forms for local conditions can be selected. Such locally adapted forms may be termed " ecotypes," and ecotype selection is now recognised as the most promising method of herbage plant improvement; it is merely a refinement of the conception of the indigenous strain. Oswald (Ref. 10), in describing such methods of improvement in Sweden, maintains strongly that seed adapted to the needs of any particular region can be produced only within that region. It is therefore considered wrong to import seed from other areas, or even to send stock seed of selected strains to be grown on in other areas where seed could be produced more cheaply. The ideal at which to aim is, therefore, local seed-growing by farmers in all parts of the country; only by such means is it possible to maintain the hereditary constitution of the unstable population of plants which constitutes the local strain. In Finland the old local strains are generally the most reliable, and legislation was introduced in 1937 to prohibit, until further notice, the importation of seed of certain species; exceptions are made in certain particular cases, *e.g.*, timothy from Estonia, red clover and alsike clover from Sweden, Norway, Latvia and Estonia (Refs. 11 and 12). But while the development of local strains is being strongly advocated by many authorities, the possible value of imported strains is also recognised (Refs. 13 and 14). Jenkin, for example, considers that strains from different latitudes may be used to prolong the season of growth, because strains from lower latitudes possess a longer growing season than the later, more persistent strains indigenous to more northern areas.

As has already been said, wild species of herbage plants are mixed populations upon which natural conditions exert a selective influence. It has been shown by many workers that the population character of a species growing under one set of conditions may differ fundamentally from that of the same species growing in a different environment. A recent account is given by Kemp (Ref. 26) in which he states that Kentucky blue grass (smooth-stalked meadow grass) growing in permanent swards varies in character according to the management of the sward, the more prostrate types, for instance, being associated with grazing conditions and more erect types occurring in swards that have been frequently mown for hay. Similar differences were found

for white clover and cocksfoot, but in all cases there was considerable variability within the forms selected from the different areas. Selection of improved strains of herbage plants therefore exploits the natural selection which has already taken place, and takes advantage of the variability of the natural types. A selected strain is a group of individuals varying somewhat amongst themselves, but all conforming, in greater or less degree, to a certain basic type. This situation is conditioned by the fact that the material on which most breeders have worked is normally cross-pollinated, and shows varying degrees of self-sterility. In self-pollinated species such as wheat, barley and oats it is the normal procedure to develop an improved form from a single plant, though some authorities consider that selection should be practised on the broader basis of several plant initials (Ref. 15). This might ensure a wider range of adaptability for the improved strain. However this may be in the case of cereals, there is certainly a strong argument for the procedure in herbage plants, which are exposed to the fluctuations of environment to a greater degree than are corn crops. On the other hand, this does not necessarily mean that it is undesirable to attempt the selection of self-fertile forms of herbage plants. Williams (Ref. 16) however, maintains that this is undesirable in the case of red clover because of the loss of vigour which, in his experience, follows self-pollination. It is important to realise, however, that Williams' work was conducted with normally cross-pollinated lines, and there is no essential reason why self-pollinated lines should not be isolated which are as vigorous as the cross-pollinated ones. It is significant that self-fertility is being sought by many workers in herbage plants and in other normally cross-pollinated plants such as sugar beet. This has already been mentioned in connection with the American work on grasses (Ref. 7); and is also discussed for red clover and white clover by Pieters and Hollowell (Ref. 17). Bell (Ref. 18) reports that the grass and clover breeders at Svalöf are making a special study of self-fertile strains and, far from finding impaired vigour in such strains, these investigators have demonstrated a greater vigour in certain self-fertile forms. The Svalöf breeding work is at present more concerned with the search for self-fertile strains than with the hybridisation of cross-fertile ones and, in addition to the selection of twenty-two self-fertile strains of red clover (which appear to be more vigorous and higher yielding than the cross-fertile ones), a new self-fertile strain of red fescue, called Viking, has been put on the market. It is claimed that white clover thrives better with the Viking strain than with others, because of its less tufted habit.

The production of the seed of indigenous strains on sound economic lines is a matter of great importance to the farmer if

he is to obtain the benefit of the recent breeding work on herbage plants. Evans discusses the problem of the seed grower in References 19, 20 and 21, and draws attention to the diametrically opposed aims of the seed grower and the farmer in the case of the leafy pasture strains of grasses. The seed grower is handicapped by such things as shortness of stem, smallness of seed, variation and lateness in time of flowering and ripening, and slowness of growth in the seeding year. These disadvantages may, however, be overcome to some extent by the choice of a suitable soil and position and by the correct technique of sowing, cultivation, manuring and grazing. A detailed account of these matters is given in Reference 20, while the whole process of grass-seed production, and of the organisation involved, is described in a special bulletin (Ref. 21). Miln discusses the matter, from the point of view of the seed trade, in Reference 22.

The whole question of seed production has, in fact, been receiving considerable attention in recent years. Experts on the subject in America, Europe, and this country have written accounts of the methods employed for leguminous forage crops in their particular areas, and these have been published in a Bulletin of the Imperial Bureau of Plant Genetics (Ref. 23). A further bulletin of the same series deals with the insect and other pests which damage the seed crops of herbage and forage plants (Ref. 24). Finally, a recent book by Mercer (Ref. 25) should be mentioned, in which an account is given of the commercial production of the seeds of farm and garden crops, together with an account of seed testing and weed seed impurities.

Growth Habit and Rhythm.

The behaviour of herbage plants in a sward is to a large extent determined by their habit of growth, rhythm of growth and food-storage characteristics. Smelov (Ref. 27) maintains that a knowledge of the characteristic features of food reserves in perennial plants is necessary for a proper understanding of their behaviour and of their power to reproduce themselves vegetatively. Such knowledge is also valuable in relation to the best time and height of cutting, the over-wintering power, and the nutritive value of the new shoots in spring. Smelov has studied timothy in detail, and found that cutting at 1 cm., 5 cm. and 10 cm. respectively showed different effects on the subsequent growth of the plants. In the first case the shoots died off in large numbers, but a great many new ones were formed; in the other two cases there was no great shoot mortality, and only a few new shoots were formed. When grazing was practised on this species, at a time when the growing points of the shoots had risen to grazing level, it prevented their further growth, and new shoots were formed. This, however, reduced

the subsequent yield. Rhythm of shoot production, and shoot mortality, are characteristic of species, and fertilisers applied at different times will therefore produce different effects. Thus in timothy, spring applications of nitrogen did not stimulate shoot production as much as applications made in late summer, before the climax of shoot production.

The fact that part of the developmental cycle of plant growth can be completed before the winter is very important in relation to the capacity of the plants in a sward to over-winter satisfactorily. In grasses, winter-hardiness and the power to develop winter-hardiness, fall rapidly as the growing points of the shoots develop and become differentiated. It is suggested in Ref. 30 that grassland impoverishment is sometimes due to the inefficient control of the development of basal shoots, which can be affected by mowing, grazing and manuring.

Both Smelov and Klapp (Ref. 28) allude to the importance of the amount of green tissue, left after defoliation, in affecting the power of a grass to withstand repeated grazing or cutting. Smelov found that the failure of a brome grass to withstand cutting, compared with the success of smooth-stalked meadow grass, was due largely to the fact that the former drew on its food reserves to form new shoots, while the latter always had young leafy shoots at the base, which quickly started to manufacture more food reserves. The period of rest is also important as affecting survival, in so far as it allows of the development of new shoots. Bates (Ref. 29) has described the effect of the life-form and structure of grasses and weeds in pastures on their ability to withstand different mechanical treatments. Thus smooth-stalked meadow grass, perennial ryegrass and cocksfoot can withstand heavy treading because of their folded leaves and protected growing points, while the control of such weeds as daisy, creeping thistle and stinging nettle is also dependent on their life-form.

Species and Strain Behaviour.

Investigations on the comparative behaviour of indigenous and commercial strains continue to be of interest to the farmer in so far as they indicate whether the benefits which may be derived from the use of indigenous strains will justify the higher cost of the seed.

Experiments by Davies and Western (Ref. 31) at Aberystwyth, with Aberystwyth and commercial strains of perennial ryegrass, cocksfoot and timothy, indicate that the indigenous strains gave only about 60 per cent. of the establishment of the commercial strains in the early stages of the seeding year. This appears to be due partly to the inherent lower capacity for early development, and partly to the smaller size of the seed of the indigenous strains. This initial disadvantage is not considered

to be a serious matter, because there is not a great difference in the final number of plants, and because the indigenous strains tiller more profusely, and are more persistent. Further experiments by these workers demonstrated that perennial ryegrass had a greater depressing effect on Montgomery red clover and wild white clover than had cocksfoot or timothy, while mixtures of the grasses had a greater depressing effect than any single grass. In all cases red clover promoted a better establishment of the grasses when grown in conjunction with them. The possible reasons for stimulation of a non-leguminous species when grown in conjunction with a leguminous species will be discussed in a later section of this article.

Thomas (Ref. 32) has also made observations on perennial ryegrass, cocksfoot and timothy in swards which had been down for five, seven and eight years respectively. The competition between indigenous strains of these grasses is discussed, and the superiority of ryegrass under conditions of high fertility, and cocksfoot under conditions of low fertility, is once more demonstrated. Timothy was not a good competitor in such mixed swards; it is a grass suited to heavy land and peat, under which conditions it should be made the dominant species. The use of rough-stalked meadow grass, red fescue and Chewings fescue as bottom grasses and weed suppressors is also referred to in this paper. In a second paper, Thomas (Ref. 33) maintains that simple mixtures of suitable strains can be as satisfactory as more complex ones. Mixtures of Italian ryegrass, hay and pasture strains of perennial ryegrass, and wild white clover have been successful and under Welsh conditions may be grazed five or six weeks after sowing. It is interesting to note that improved leafy strains of certain species outyielded commercial strains both as hay and pasture over a number of years, and also resisted weed invasion more successfully. It is, however, advised that the more rapidly growing commercial strains be always included in mixtures, in order to provide early keep; but they must be so managed as to prevent their smothering the slower-growing indigenous strains.

In an account of species and strain experiments in Holland, van Daalen reports that Dutch strains of perennial ryegrass were superior to Aberystwyth, Danish, Kentish and commercial strains (Ref. 34). It is interesting that van Daalen in Holland, and Bruce Levy in New Zealand, both refer to the unsuitability of rough-stalked meadow grass for pasture formation. The former states that, in Holland, this grass crowds out other grasses and is useless in dry years. The latter reports that it has reduced the yields of swards in New Zealand (Ref. 34).

Findlay (Ref. 35) draws attention to the limitations of the late leafy pasture strains of grasses for temporary leys in the

north of Scotland. The more general use of wild white clover has vastly improved the temporary pastures; this clover thrives better in association with the stemmier strains than with leafy indigenous types, and so stimulates the former that they are more satisfactory than the latter. This consideration, coupled with the earlier growth of the stemmier strains, prevents the wholesale adoption of the indigenous strains. These, however, should always be included in order to prolong the growing season. During various discussions at the Grassland Congress (Ref. 1, p. 68, 89 and 221) Laird also reported that commercial strains of perennial ryegrass were as satisfactory as indigenous strains in the west of Scotland. He maintained that wild white clover is by far the most important of the indigenous plants, and that "good soil and management are more important than seeds mixtures." Further doubts as to whether the superiority of indigenous strains in their second and subsequent years outweighs their inferiority in the first year, their lateness in spring and their low seed production are expressed by Mercer and Linehan (Ref. 36).

Johnstone-Wallace (Ref. 37) has found that wild white clover exerts a most important influence on the pastures of the north-eastern U.S.A., where the temperature fluctuations are greater than those experienced in this country. The increased yield from a sward containing wild white clover under these conditions appears to be partly due to the action of the clover in reducing the seasonal fluctuations of soil temperature. This species also provides almost complete control over soil erosion, and greatly reduces the quantity of water which runs off the surface during heavy rains.

Seeds mixtures for poultry runs have not received much attention in grassland investigation, but Robinson (Ref. 38) has conducted some experiments on this problem. He states that the important qualifications for such a mixture are that it should produce an even cover throughout the year and should supply vitamins and protein to the poultry. The basis of successful mixtures in Robinson's experiments has been indigenous perennial ryegrass (16–20 lb.) and smooth-stalked meadow grass (8–10 lb.). To these are added 3 lb. each of creeping bent grass (*Agrostis tenuis*), Chewing's fescue and crested dogstail, and $\frac{1}{4}$–$\frac{1}{2}$ lb. of wild white clover. The ryegrass and crested dogstail are winter green, and the smooth-stalked meadow grass forms the desirable hard-wearing turf, which is maintained by the Chewing's fescue and creeping bent, these latter species being not very palatable.

Management.

It is becoming increasingly difficult to separate the various aspects of grassland management, such as manuring, grazing, etc.,

and to treat them separately. The reason is that much of the experimental work involves more than one aspect of management, and in many cases strives to correlate the effects of two or more factors. In this section, therefore, no attempt will be made to consider the different management factors under different headings.

It is generally accepted that the low productivity of much grassland in this country is due to neglect and mismanagement. But it costs money to improve poor grassland, and the more intensive forms of grassland management are also the most expensive. Farmers must feel convinced that the extra expense will bring an adequate return. Thus, it is relevant to mention two articles on the economics of grassland management (Refs. 39 and 40). In both of these, Orr brings forward evidence to show that intensive management, heavy manuring and the use of temporary leys are often profitable; it pays to spend money on improvement, and the savings effected through neglect are false economy.

The effect of nitrogenous fertilisers on swards in Sweden and Holland are described in References 41 and 42. In the Swedish experiments the pastures received heavy dressings of nitrogen and were rotationally grazed and well managed. The better grasses were encouraged. Spring applications gave grazing five to eight days earlier. Summer dressings increased the amount of keep during the dry months, the effect being more marked in moderately dry than in wet seasons, but less again in seasons of severe drought. The author advocates the use of nitrogen to maintain growth during critical periods of the grazing season. The Dutch results are more complicated because the experiments involved different systems of management in conjunction with the nitrogenous dressings. When the swards were grazed rotationally each month, or continuously throughout the season, the general effect was to increase perennial ryegrass and wild white clover, and to decrease rough-stalked meadow grass and weeds. Grazing at the beginning of May, and cutting hay at the beginning of July similarly increased the perennial ryegrass and decreased the weeds, and nitrogenous dressings emphasised these effects. Mowing in June and grazing in July appear to have depressed the clover, and the stimulating effect of the nitrogen on perennial ryegrass was not apparent, while the botanical composition of the aftermath depended largely on the weather conditions at the time of mowing. No increase in the valuable grasses was obtained by nitrogenous dressing when the swards were mown in the middle of May and again at the beginning of July.

Brenchley (Ref. 43) describes experiments on hay swards at Rothamsted which have been conducted continuously since 1856.

The effect of repeated one-sided manuring over a number of years may be seen in several ways—in the number of species present; in the relative proportions of the species; and in the amount of growth. Nitrogenous fertilisers were the most potent in reducing the number of species, and sulphate of ammonia was more drastic in this respect than nitrate of soda. The use of mineral fertilisers, chiefly potash and phosphate, without nitrogen, did not seriously affect the botanical composition, but encouraged some species, *e.g.*, of leguminous plants. It is important to note the difference between the action of sulphate of ammonia and nitrate of soda; the soil acidity induced by the use of the former suppressed many species, and the proportion of miscellaneous herbs was larger with the nitrate of soda. It is also interesting that lime by itself, or with a one-sided mineral dressing, had little effect on the yield or botanical composition of the sward. With a complete mineral dressing, however, lime increased the yield, and the botanical composition was altered.

The effect of phosphate dressings on a timothy ley, situated on a fen soil to which clay had been previously added, is described in Reference 44. Small amounts of other grasses such as rough-stalked and smooth-stalked meadow grasses, meadow fescue and cocksfoot were present, but the smooth-stalked meadow grass was the greatest competitor with the timothy. It was found that phosphorus was most important for the persistence of timothy and became more so as the ley aged. Further experiments on intensive fertiliser treatment, accompanied by rotational grazing, are reported by Drew and Deasy in Ireland (Ref. 45). The effect of the treatment was measured by live weight increases of sheep and cattle, but unfortunately no detailed account is given of the botanical composition of the swards. The results showed that 50 per cent. of the increase was due to the phosphatic and potassic dressing. Where these were used alone, the herbage was improved and suffered less from adverse weather than that receiving nitrogen as well. Heavy applications of nitrogen, in addition to the basic phosphatic and potassic application, increased the productivity, suppressed weeds but also suppressed clover. It was calculated that 30 per cent. of the total live-weight increase was due to the nitrogen, mainly by reason of the earlier growth which was induced. The remaining 20 per cent. of the increase was due to the rotational grazing. Jones (Ref. 46) draws attention to the importance of recording the botanical composition of the herbage in experiments in which it is desired to measure sward productivity in terms of stock-carrying capacity. His experiments at Aberystwyth demonstrated that wild white clover, added to perennial ryegrass or cocksfoot, or to a mixture

of these two grasses, increased the animal production, but the clover-ryegrass mixture was more effective. Over a period of four years, leafy Aberystwyth strains were more productive than commercial strains, and the increased cost of the seed of the former was amply repaid.

Investigations on the rotational grazing of irrigated permanent pastures in Australia have led the experts to advise longer rests than have been customary between grazing periods in order to avoid too drastic defoliation of the plants (Ref. 47). A 36-day rotation on 18 paddocks is recommended, with a stocking of 200 to 300 sheep per acre during the actual grazing. This report on pasture investigations also includes an account of the absorption of small amounts of nitrogen by grasses grown in association with leguminous plants. (*See* Section IV below.)

Martin Jones (Ref. 48) asserts that more stress is now being laid on management, particularly grazing management, than on the seeds mixture sown as affecting the botanical composition of a grass sward. This applies particularly to the clover-grass ratio, in which a suitable balance must be maintained intermediate between the grassy sward, which is early in spring but fails in the summer, and the clovery sward which is late in spring but contributes good summer growth. The best swards possess a suitable balance of grass and clover, and this can best be achieved by adjusting the stocking throughout the year according to the amount of growth available. In a further article (Ref. 49) Jones gives a simple account of the effect of grazing at different times of the year on the growth of individual species and on a mixed sward, reference being made to the action of manures in compensating for the check to growth that is caused by defoliation. It is therefore necessary, if we are to control the proportions of the various species in the sward, to understand the behaviour of each and especially to know the period of the growth-flush of each.

Baker (Ref. 50) has studied the botanical composition of some very old alluvial meadows which are periodically flushed by the river Thames. These meadows have been either grazed, or mown for hay with the aftermath grazed, for centuries, each meadow having continuously received the one or the other of these treatments. Ninety-five plant species were found in the meadows; of these 23 were grass species, 3 clover species, and the remainder miscellaneous herbs. The significant fact arising out of this study is that 39 species were confined to the hay meadows and 26 occurred on the grazed meadows only. Apart from the obvious differential effects of the grazing and mowing, the distribution of the species within the areas was also conditioned by the degree of wetness of the soil.

THE IMPROVEMENT OF POOR GRASSLAND.

The most rapid and economical ways of improving poor grassland continue to be the object of much research. A general survey of the methods being employed is given in Reference 51, in which there is also a discussion of the characters which determine the agricultural value of a species of herbage plant. These characters are yield, seasonal productivity, winter-greenness, persistency, aggressiveness, competitive ability, power of recovery, accessibility for grazing, power of establishment and freedom from diseases. The possibilities of profitable improvement by breaking up and resowing depend mainly on the condition of the pasture and on its accessibility. In a general discussion of the types of poor pasture which should be broken up, Oldershaw (Ref. 52) offers a choice of several methods. When pastures are composed of poor grasses, and are infested with weeds, it may be necessary to fallow and put the land through a short rotation before re-seeding. Better types of pasture can be prepared for re-seeding more quickly and with less labour. Oldershaw also discusses the use of various crops for the rotation that precedes the re-seeding, and the conditions under which re-seeding may follow directly on the breaking up of the old sward. This latter point is also discussed by Kirkwood (Ref. 53), who emphasises the importance of close grazing, and mowing if necessary, before the old sward is ploughed. Dressings of phosphate and potash fertilisers, and of lime are advocated, in all cases, by Kirkwood, who claims that a worn-out pasture can be replaced by a good young sward for a cost of £3–£4 per acre. This sum is easily recovered in the improved grazing of the first two years. Further experiments in Scotland on direct seeding after ploughing up have shown that practically any well-balanced mixture is satisfactory, provided only that the cultivations have been thorough (Ref. 54).

The harmful effect of sheep on the hill grazings of Scotland is now well recognised, the heather being killed out and its place being taken by bracken and mat-grass (*Nardus stricta*). Fenton (Ref. 55) has shown that if mat-dominant areas are fenced against sheep and cut regularly, the mat-grass is reduced, and that fescue species and *Agrostis* then tend to become the dominant plants. This occurs whether manures are added or not. It also occurs when manures are added and the areas are left exposed to grazing; fencing alone, to exclude grazing animals, has produced the same results. If skimming or ploughing is practised, and the land is fenced, *Agrostis*-fescue colonisation takes place, but the mat-grass begins to spread rapidly as soon as the sheep are allowed to graze. There is no doubt, therefore, that sheep are responsible for the material

alteration of the vegetation of parts of the hill areas of Scotland. When areas are bared by burning or other means, the sheep seriously interfere with the regeneration by desirable species, so that mat-grass may again become the dominant plant.

II.—POTATOES.

Breeding.

Potato breeders throughout the world are still engaged in the difficult problem of producing varieties resistant or immune to Late Blight (*Phytophthora infestans*) and to the more important virus diseases. Apart from the disease question, all breeders are of course concerned with yield and quality of the tubers, while in certain countries frost- and drought-resistance are matters of considerable importance in the breeding work.

The peculiar origin and history of the varieties in the important potato-growning countries has led many breeders to conclude that the only means by which radical improvement can be made with regard to disease-, frost- and drought-resistance is by making use of the South American forms for hybridisation. A full account of the history of the cultivated potato will be found in References 56 and 57. The South American forms which are, or promise to be, useful for breeding purposes are discussed in References 57 and 58. It must suffice here to point out that all the potato varieties now being cultivated on economic lines may be included in three groups, and that the great majority are very closely related one to another. These varieties do not possess the highest degree of resistance or immunity to diseases, nor do they show sufficient variability, from the plant breeder's point of view, in many of the other desired characters. Consequently, it is considered necessary to seek "new blood" and to introduce the desired characters by hybridisation.

Salaman (Ref. 59) describes how the selection which has taken place during the last 350 years, within the restricted stocks available, has probably resulted in the loss of many valuable breeding characters as well as the elimination of economically undesirable ones. Coloured skin and coloured flesh of the tubers, resistance to Late Blight and frost, true sexual fertility, and susceptibility to Wart disease (*Synchitrium endobioticum*) are examples of desirable and undesirable characters which have been, or are being, bred out of the available stocks. In some cases desirable and undesirable characters may be genetically linked so that, in the process of eliminating the latter, the former may also be lost. There is, for example, evidence that the desirable character of tolerance to some virus diseases is linked with deep eyes, long stolons and highly-coloured tuber skins,

none of which is a character that the breeder desires. The need for new breeding material arises whenever it seems desirable to introduce a character that does not exist in the available stocks. At Cambridge, hybrids of commercial varieties with the South American species *Solanum demissum* have resulted in forms combining resistance to Blight with high yield and good tuber characters, some forms even showing resistance to the new forms of Blight. Salaman maintains that, although there is no evidence of hereditary resistance to viruses, there is some evidence of hereditary tolerance. There is at present very little likelihood that the breeder will be able to produce forms immune to such virulent virus diseases as Leaf Roll and Leaf Drop Streak.

In America, on the other hand, it is considered that sufficient resistance to the particular biologic forms of Blight occurring in certain areas can be obtained by selfing and hybridising suitable commercial varieties (Refs. 60, 61 and 65). The best hybrid combinations are being tested, and many resistant forms have already been obtained in various ways—by selfing a susceptible variety, by crossing two susceptible varieties, by crossing a resistant and a susceptible variety, and by crossing two resistant varieties. The object of this work is to obtain varieties which are sufficiently resistant to obviate the necessity of spraying. Resistance to Scab (*Actinomyces scabies*) has been obtained in the same way. Although resistance to Scab appears to be associated with certain visible characters of the tubers (see below), no association has yet been found between any visible character and Blight resistance (see also Ref. 64).

The Americans are, however, also using the South American species for breeding forms resistant to Blight. They consider that *Solanum andigenum* is the most promising species for this purpose (Ref. 61). Bukasov (Ref. 62) also reports good results from the use of this species; he also considers it most important for the breeding of high yielding forms, because he has obtained hybrids between it and commercial varieties which outyield commercial hybrids. On the other hand, Bukasov states that hybridisation with *S. demissum* is the most hopeful method of obtaining Blight immunity, and he refers to Salaman's work in this connection.

Russian workers claim to have produced two Blight-resistant varieties (Lutzow and Schenkendov) by hybridisation involving the use of twenty-two different varieties, while two other varieties (Tschugunka and Salatuy), which arose as mutations, are more resistant than the stocks from which they came (Ref. 66). It is also stated that the most promising South American species, from the point of view of breeding resistance to Blight and obtaining good tuber formation under long-day

growing conditions, are native to Bolivia and Columbia. The geographical area of immune forms is Mexico.

The South American species also show other valuable breeding characters such as great variability in the tuber content of vitamin C, protein, starch, etc. There seems to be considerable scope for improvement of these characters, if desired, in commercial varieties. Clark (Ref. 63) refers to work by Schwarz and Kuzmin in which forms with higher protein than either parent were obtained by crossing *Solanum plureja* and *Solanum rybinii.*

Efforts are being made in the United States to combine drought tolerance with Blight immunity by hybridising commercial varieties with *Solanum demissum.* The back-cross method is being used, as is usual with such inter-specific hybrids. Although Blight immunity and good tuber characters have been combined, the drought tolerance did not persist for more than three or four generations in the hybrids which were selected for the other two characters.

Breeders are considerably handicapped by the widespread occurrence of pollen sterility in potato varieties, and this character, coupled with the heterozygous condition of all varieties, is one of the most important considerations in potato breeding. A search for pollen-fertile varieties has been made in the United States, and with the finding of two good pollen varieties (Katahdin and Ekishirazu) the position has improved considerably (Ref. 68). Self-pollination in potatoes may result in a loss of vigour, but it is possible by this means to produce forms carrying characters desirable for breeding. The recent intensive breeding work in the United States has produced four new varieties resistant to mild mosaic—viz., Katahdin, Chippewa, Golden and Houma, and also many unnamed varieties, resistant to Blight and Scab, which are now undergoing field trials. A full account of this work will be found in References 68, 69 and 70.

Attempts to produce improved early varieties by hybridising commercial varieties, and by inter-specific crossing with *Solanum andigenum,* are described by Veselovsky (Ref. 71). These early forms are usually unproductive, and have to be back-crossed to improve their yields. Crosses between Epicure and Cobbler, and between Di-Vernon and Cobbler, have resulted in forms earlier than either parent, while Epicure crosses with *Solanum andigenum* have been satisfactory for yield, early tuber formation, and early completion of vegetative growth.

Disease Control, Etc.

Successful experiments on the control of Blight development in the tubers of the variety British Queen are described by Grewes (Ref. 72). Every effort was made to ensure that the tubers were properly infected, by slashing them with their

haulms which were known to be actively producing spores. If the tubers were treated immediately, with either a mercuric chloride steep (90 minutes in a 0·1 per cent. solution) or with an instantaneous dip of a proprietary organic mercury compound (30 seconds to one minute in a 1·0 per cent. solution), very satisfactory control was obtained. If, however, there was a delay of four days in the treatment, there was little success in preventing the development of the Blight. There was also evidence that wounding of the tubers prevented good control. The disinfection did not injure the subsequent sprouting of the tubers. The author states that when wet weather follows digging, greening of the tubers is not likely to control Blight.

It has been shown by investigators that under certain conditions, infection of tubers by Scab (*Actinomyces scabies*) is limited to a period of approximately 10 days after the tubers begin to set, and that high soil moisture at this time discourages infection (Ref. 73). In this work, resistance to Scab infection has not been found to be associated with a russetted skin, as is very commonly assumed; some of the most resistant of the seedlings studied possessed smooth skins. The most important character of the tuber in determining resistance, appears to be the type of pore (or lenticel) in the skin. Resistant forms possess relatively large lenticels with smaller, more oblong and more closely packed cells underneath the opening (the complementary cells); the outer cells are also strengthened by cork. The incidence of the disease in a crop is also affected, however, by the character of the soil, and fertility, soil moisture, temperature, acidity or alkalinity, must all be considered.

Mader and Mader (Ref. 74) have found that spraying with Bordeaux mixture reduces the amount of infection by Scab. Their results also suggest that infection occurs in the early part of tuber formation, although there was a higher infection on the larger tubers than on the smaller ones; this was possibly because the disease had had a longer time in which to develop. In these experiments the spray was applied at the rate of one hundred gallons per acre in each of six applications, the strength of the solution being calculated to give at each spraying approximately an equal amount of copper to each unit of exposed leaf surface. This procedure has been found to give larger yields, and better grades of tubers, than that of applying equal amounts of copper throughout, or increasing the amount of copper in the latter part of the growing season. Spraying exerted a considerable effect on the growth of the plants, there being a higher total leaf weight and a heavier yield of tubers. This greater final tuber weight appears to have been due to a greater and better sustained power of tuber development on the part of the sprayed plants, although the rate of tuber development in the

early stages was greater in the unsprayed plants. Apart from the greater total yield of tubers from the sprayed plants, the spraying affected the composition of the tubers in respect of their content of nitrogen compounds, carbohydrates, iron and tyrosine (a substance said to be associated with tuber blackening). The spraying produced a higher ratio of nitrogen compounds to carbohydrates in the earlier stages, a more rapid increase in the starch as growth progressed and a reduction in tyrosine and iron, which, in turn, reduced the tendency to blackening of the tubers.

Stapp (Ref. 75) has tried to discover associations between obvious varietal characters and resistance to Black Leg and Wet Rot diseases caused by *Bacterium phytophthorum*, Appel. He tested 25 varieties, only one of which proved to be resistant; the only association he could find was that the susceptible varieties were mostly yellow fleshed. The other characters which he studied were time of ripening, thickness of skin, capacity to form wound cork, starch content and rate of decomposition of the flesh, but no definite association showed itself between these and resistance to the bacterial attack.

Viruses.

At present virus control in potatoes in this country is effected by the growing of virus-free stocks in special areas. In connection with the scheme to produce certificated stock in North Wales, considerable work has been done to investigate the conditions most suited to the production of virus-free seed, and to discover the reasons why certain areas can be used for this purpose. Davies (Ref. 76) has found that the behaviour and migration of the aphids, now generally accepted as being responsible for the transmission of certain viruses in the field, is of vital importance to the degree of virus infestation. It was noticed, for example, that the aphid *Myzus persicae*, which carries leaf roll and mosaic diseases of the potato, over-winters as wingless adults and young on the plants of winter Brassicae (*e.g.*, brussels sprouts and savoys) and on weeds of the family *Cruciferae*, in market garden areas. This results in a steady production of young through the winter and a consequently much earlier production of winged migrants in the spring. It is these winged forms which infect the potato crops. Meteorological conditions, however, have a very important effect on the migration of this insect, and the initial population on the summer host, as well as the intensity of migration back to the winter host, is influenced by such things as temperature, humidity and wind velocity. Surveys of various areas have shown that the aphis population is directly associated with the prevailing weather conditions, there being very few insects in areas characterised by low temperatures, high humidity and high wind velocity. Whitehead (Ref. 77)

describes the application of this work to the scheme for producing Certified Welsh Stock potatoes, and attributes the success of the seed-growing areas to the pastoral conditions and the climate of the western sea coast zones which are used. It has also been found that in those districts of North Wales where degeneration is rapid, early lifted, immature seed is healthier, and gives heavier crops, than seed lifted at the normal time.

A potato variety may be infected with a particular virus and yet show no symptoms. Such a variety is termed a "carrier" and may be a possible source of infection to healthy stocks. Whitehead (Ref. 78) maintains that evidence is accumulating to show that a carried virus may reduce the susceptibility, or even induce immunity, to attacks by another virus. This reduced susceptibility of carriers may explain why the oldest and best varieties such as King Edward, Up-to-Date and Champion are carriers of certain viruses. Whitehead conducted field experiments to see how far the carrier varieties King Edward and Up-to-Date are potential sources of infection to susceptible varieties grown in proximity. He could find no evidence of field transmission, and concludes that these two carriers are not such a grave danger to other varieties as is often stated.

Accounts of testing some American potato varieties for susceptibility to certain viruses are given in References 79 and 80. There were very definite varietal differences in susceptibility and resistance. Chippewa, Green Mountain and Russet Burbank showed some resistance, compared with the very susceptible varieties, to Veinbanding Mosaic, while Katahdin was highly resistant to Latent Mosaic in addition to the former disease. Seedlings obtained by self-pollinating some varieties showed varying degrees of susceptibility to the Mosaic diseases, and it was possible to calculate the proportions of seedlings susceptible and resistant to those viruses. In the case of Spindle Tuber, however, a wide range of reaction was found among the seedlings, and, as in Leaf Roll, no conclusive results were obtained. It is important to realise that the terms "resistant" and "susceptible" are used very loosely in the account of this work; although a variety may fail to contract a virus in the field, it may be possible to infect it by leaf rubbing with a diseased plant, or by grafting it on to a diseased stock. In the experiments described in Reference 79 a seedling termed S 41956 did not contract Latent Mosaic in the field, by leaf rubbing, or by grafts. Katahdin, on the other hand, was highly resistant to the same virus in the field, but was infected by grafting.

Varieties.

A short description of the new potato varieties available to growers in this country, and of field trials conducted by the

National Institute of Agricultural Botany, were given in last year's article on Crops and Plant Breeding. Two further new varieties, one produced in the United States and the other in British Columbia, should be of interest to growers and breeders. The first, Columbia Russet (Ref. 81), is a promising early main-crop variety which has recently become popular in British Columbia. As its name implies, it is russetted, and is white fleshed and shallow eyed. It yields well, has a high percentage of ware, is a good keeper, is suitable to drier areas, and can withstand light frosts. This variety is a good example of the taking into cultivation of a new sort showing desirable economic characters, in spite of its susceptibility to all diseases. The second variety, Houma (Ref. 82) is a hybrid between Katahdin and Charles Downing. It is resistant to Mild Mosaic, yields well and possesses good cooking qualities. It is suited to spring and autumn planting in Louisiana, sets a large number of tubers, and keeps well.

Drought.

The effect of drought on the growth of potatoes has been studied by Murphy in Ireland (Ref. 83). The first signs of abnormality were noticed by the occurrence of soft tubers, which apparently had given up water to the rest of the plant. These tubers sprouted prematurely and absorbed larger amounts of water than the normally hard ones. In addition to the softening of some of the tubers, various other effects of drought were observed, such as hollow heart, prolongation of the tubers, formation of tubers in chains, second growth of tubers, premature sprouting of tubers in the soil or afterwards, and cracking of tubers when growth was resumed after the drought. Various pathological conditions also appeared to be due to the lack of water, although no organism was, of course, responsible. Stem End Wilt, which appears to be due to the drawing of water by the foliage from the tubers, Glassy-end and Jelly-end Rot due to the absorption of organic food material from the tubers by the foliage, and Drought and Heat Necrosis are all apparently attributable to the same cause.

It is, of course, difficult to separate the effects of drought from the effects of heat. Murphy states that high temperatures do not cause much harm in Ireland, whereas in America high temperatures are considered more important than droughts, and may be injurious even when no drought exists. Drought without heat is considered to be harmless in America, and some American varieties are resistant to hot dry weather. On the other hand, most north-western European varieties are very susceptible to such conditions.

III.—HYBRID VIGOUR OR HETEROSIS.

Practical Applications.

The conception of hybrid vigour or heterosis is, of course, not a recent one. The phenomena have been observed in plants and animals for many years, although it was not until 1918 that any acceptable hypothesis was put forward to explain them. Hybrid vigour implies that the first generation progeny, resulting from a cross of two individuals, shows greater vigour of growth or development than that of its parents. In some cases hybrid vigour has been claimed where the hybrid is more vigorous than the *average* of the two parents, but it is more properly restricted to those instances where the hybrid exceeds the vigour of the more vigorous parent. In plants hybrid vigour can obviously manifest itself in many ways, and observations on greater height, heavier yields of fruit or seed, larger fruit or seed, larger leaves, and greater vegetative growth in general are often recorded. Experimental work on hybrid vigour may therefore be concerned with several plant characters, or it may be confined to the expression of vigour in one character only.

Although hybrid vigour is accepted and exploited in such cultivated plants as maize, sugar beet, some grasses, clovers, etc., there is as yet no explanation of the facts which can be considered as entirely satisfactory. Maize, and to a lesser extent red clover, are good examples of crop plants in which hybrid vigour is being more or less systematically exploited in the production of improved varieties, and there are other cases where the hybrid nature of cultivated forms appears to be largely responsible for the vigour of their growth. Recently many new examples of hybrid vigour have been recorded in plants and new attempts have been made to take practical advantage of the phenomenon. This work will be referred to first, and will be followed by a short account of the controversial points that have arisen in attempting to arrive at a theory of hybrid vigour.

Hadfield and Calder (Ref. 84) and Driver (Ref. 85) have conducted experiments in New Zealand on the commercial use of hybrid vigour in tomatoes, a crop in which large numbers of seeds may be produced cheaply. Various combinations of varietal crossings showed that it was possible to produce hybrid forms which were in some cases higher yielding, and in others earlier maturing, than either parent. An important aspect of this work, and also of investigations conducted by Daskaloff (Ref. 86), is that it was found possible to increase not only the total yield of fruit, but also the amount of fruit picked in the early part of the season. Daskaloff's hybrids can only be said to have yielded more heavily than the average of their two parents,

but he states that one first-generation hybrid is being grown commercially in Bulgaria, and that it excels other varieties in earliness, yield and quality. The New Zealand workers refer to the importance of trying all combinations of varieties for the production of hybrid seed for different conditions and markets.

Kadam *et al* (Ref. 87) observed hybrid vigour in some rice crosses which resulted in increased yield of grain, but failed to establish any effect on the height, number of ear-bearing stems, length of panicle or total weight of the plants. Kerper and Quinby (Ref. 88) found that crosses between different types of sorghums showed extraordinary hybrid vigour, some of the hybrid plants being two-and-a-half times as tall as the taller parent, and producing three times as much fodder and grain. Extreme vegetative growth, accompanied by lateness of maturity, was characteristic of some crosses, while the excessively tall hybrids also possessed thick stems, large, dark leaves, extensive root systems, and high tillering capacity. The significance of this work on sorghums is that hybrid vigour could express itself in different ways with different crosses—lateness, earliness, height, yield, leaf size, endosperm size—and that, by choosing suitable parents, various character expressions could be obtained at will. The authors state that the various sorghum varieties at present cultivated are true breeding for many of the hereditary factors which depress the vigour of growth. It should therefore be possible to produce hybrid varieties of various types possessing dominant factors favourable to growth, and consequently greatly superior to the varieties in use. Coffman and Davies (Ref 89), working with oats, also observed that the manifestation of hybrid vigour differed with the parentage of the hybrids. Thus in some crosses the hybrid exceeded the larger parent in the weight of the plant and the grain; in others the hybrid was superior in the weight of straw; while in five cases the ratio of grain to straw was higher in the cross than in the parents. This last manifestation of hybrid vigour is important because it suggests increased efficiency on the part of the hybrids. The authors suggest that it may be possible, by studying the inheritance of the various factors controlling the size characters of the plant, to breed more specifically for particular purposes.

The breeding of red clover is very strongly influenced by the fact that the plants are normally cross-pollinated by bees, and that there is either a very high degree of self-sterility, or complete self-sterility, in the vast majority of plants. Williams (Ref. 90) reports that he has found only one genuinely self-fertile plant out of the many thousands which he has handled but, as has been said earlier, certain Swedish workers are making a special search for self-fertile forms. Williams has devoted a great deal

of attention to the vigour of growth of plants derived from in-bred and cross-bred families of red clover, and has found that in-bred seedlings are invariably weaker in growth than seedlings from out-pollinated families. He has compared the size of seedlings and young plants of first, second and third generations of in-breeding in the same family, and has found a progressive falling off with each successive generation of in-breeding, which falling-off became noticeable when the plants were in their third or fourth week of growth. The difference in plant size became very marked by the sixth week, and was still more pronounced after transplanting. There was also an increased mortality in the more in-bred plants. It appears, therefore, that in red clover, which is normally cross-pollinated, in-breeding may have very injurious effects on early vigour. There is also strong evidence that the power of the plants to persist decreases progressively with each successive generation of in-breeding. There is, however, great variability in the degree of persistency of the in-bred families, and it is possible to select for persistency within such in-bred material. Similarly, there is considerable variability in the yields of individual plants within in-bred progenies, though the heaviest yielders among these were never as high as the heaviest yielders in the corresponding cross-bred populations ; nor was the average yield of in-bred lines as high as that of the cross-bred lines. It is important to realise that it is impossible to cross certain plants of red clover, *i.e.*, they are incompatible. This cross-incompatibility often prevents the hybridisation of promising individuals within a family, though such incompatibility seldom occurs in original crosses of unrelated plants.

A preliminary investigation into the possibility of using hybrid vigour in wheat was investigated in this country some years ago by Engledow and Pal (Ref. 91). These authors point out that although it would be impracticable to grow commercial crops of first-generation hybrids, it might be possible to utilise hybrid vigour in the later hybrid generations, when the difficulties of producing large bulks of seed would be less. However, in the wheat cross studied in detail, hybrid vigour was not sufficiently marked to suggest much practical use. Other crosses, made between bread wheat varieties and also between different species of wheat, showed varying amounts of hybrid vigour. In a few barley crosses hybrid vigour was less marked.

Theoretical Considerations.

As has been said above, no explanation of hybrid vigour has yet been proposed which satisfactorily and completely explains the known facts. Some 20 years ago Jones suggested a hypothesis, based on genetical arguments, which has been accepted

by most investigators up till recent times. Ashby has, however, expressed doubts whether Jones' hypothesis is generally applicable, and has supplied evidence from his own crosses that the explanation may depend on other characteristics of plant growth. East (Ref. 92) has recently published a criticism of Ashby's work, and has contributed a valuable general paper on the facts about hybrid vigour. He maintains a strongly genetic position and states that Ashby's "physiological theory" cannot be held in the light of certain of these facts. Ashby has replied that he has never put forward any general theory, but has merely suggested an explanation of his own results, which need not necessarily apply to other plants (Ref. 93).

The details of the controversy cannot be discussed here, but the position is that Ashby explains hybrid vigour in his crosses of maize and tomatoes by the larger growing regions of the embryos of the hybrids compared with those of the parent plants. Detailed analysis of the hybrids did not show that they exceeded the parents in *relative* growth rate, as interpreted by rate of increase in height, production of leaves, leaf area, etc., but did show that the *absolute* height, weight, number of leaves, etc., was greater in the hybrids (Ref. 94). This work has been continued by Luckwill with tomatoes (Ref. 95), and this author has attempted to interpret hybrid vigour in terms of growth during flowering. Luckwill largely supports Ashby's findings, but he stresses the view that hybrid vigour need not necessarily involve a general increase in vegetative vigour, but may be seen in its effect on particular organs of a plant. Sprague (Ref. 96) has repeated Ashby's work, but failed to confirm the idea that the greater size of the embryo is responsible for the increased size of hybrids which display hybrid vigour. In Sprague's experiments the initial difference in embryo weight failed to persist, but the rate of growth in the early phases was greater in the hybrid than in either of the parents. The author does admit that hybrid embryos were, in general, heavier than self-fertilised embryos. Sprague suggests that the rate of cell division at the growing regions of plants is one manifestation of hybrid vigour, and in this connection it is perhaps significant that Bindloss (Ref. 97) thinks that the volume of the nucleus in the cells of plants may be associated with hybrid vigour.

In his most recent paper on hybrid vigour Ashby discusses some of the inheritance problems (Ref. 98). He states that any genetical theory to explain the facts must fall into line with a general explanation of the inheritance of size characters. It must be realised, however, that hereditary units or factors which determine size must affect different processes in the plant, and at different stages in its development. Therefore, as in all cases of complex inheritance of a quantitative or physiological nature,

it will probably be necessary first to analyse the processes affecting size and then to study the inheritance of these processes.

To close this discussion, reference may be made to the growing conviction among some geneticists and breeders that the phenomena of inheritance cannot be adequately explained on the classical conception of the chromosome as entirely responsible for the characters of an organism. Castle has held the view for some years that the more fundamental physiological characters of animals, at all events, are not controlled in a similar manner to the simple morphological characters. In a recent paper (Ref. 99) Castle states that there may be other structures outside the chromosomes which play their part in determining size, although there appear to be simple genetic factors, such as those for colour, which may accelerate or depress the rate of growth. Just (Refs. 100 and 101) has also published some interesting papers on inheritance and development in living organisms. He also declares it as his opinion that development can be explained satisfactorily only by considering the effect of the protoplasm outside the nucleus. Evidence for the influence on inheritance of protoplasmic structures outside the chromosomes is to be found in what is usually termed "maternal inheritance." In some cases, where reciprocal crosses are made, there is a tendency for the hybrid to resemble the female parent more closely than the male parent, the inference being that there is some influence by the protoplasm of the mother in addition to that of the chromosomes of the egg nucleus. Hsiong and Hildebrand (Ref. 102) quote experiments with the cultivated pear which they consider are strong evidence for maternal inheritance. They studied morphological characters of the leaves and stem, and also resistance to the disease known as Fire Blight, which is caused by the fungus *Erwinia amylovora*. They quote experiments by Parker on mosaic virus in the bean, which gave similar evidence of the occurrence of maternal inheritance.

IV.—THE EXCRETION OF NITROGEN COMPOUNDS BY LEGUMINOUS PLANTS.

Experiments conducted during the last ten years have shown that a leguminous plant which is actively fixing free nitrogen by means of its root nodules, may benefit a non-leguminous plant growing in conjunction with it in a sand culture. The benefit to the non-leguminous plant (usually a cereal in the experiments) is similar to that obtained by the application of a nitrogen fertiliser to the sand culture, and hence it is supposed that the non-legume is capable of absorbing nitrogen compounds which are excreted by the legume. Until recently there has been no

direct evidence that such excretion and absorption takes place under field conditions, although Swedish experiments of some years ago demonstrated that there are differences between certain species and strains of grasses in their ability to utilise inorganic nitrogen fertilisers, and that these differences vary according to whether the grass is grown alone or in the presence of clovers (Ref. 103). It is a matter of considerable importance to discover the exact relationship between leguminous and non-leguminous plants growing together in the field, whether from the point of view of grassland or that of arable crops.

A considerable amount of our knowledge, of the association between these two types of plants in sand culture, is due to Virtanen and his colleagues in Finland. In their most recent publications (Refs. 104 and 105) these workers say that the amount of the excretion depends on the strain of bacterium used for inoculation, and also on the properties of the medium in which the plants are growing. Thus, although some strains fix nitrogen vigorously, they may not excrete it to any extent, while other strains excrete in large amounts, although it may not be possible to demonstrate this excretion if very large quantities of water are used. The effect of the culture medium, the general growing conditions, and the species of plant used in the experiment are also emphasised by Ludwig and Allison (Ref. 106) and Wilson (Ref. 107). Ludwig and Allison have failed to confirm Virtanen's work by the use of sand cultures, while Wilson could not demonstrate any nitrogen excretion from such leguminous plants as peas, lucerne, soya bean and red clover. Virtanen attributes this latter failure to the use of a coarse sand medium for the growth of the plants. Bond (Refs. 108 and 109) also reports no evidence of excretion from soya beans or broad beans, but found a small excretion from peas.

Virtanen claims to have found nitrogen excretion from all the leguminous plants which have been studied in his laboratory, including peas and various perennials such as white, red and alsike clover. The plants growing in association with the legume, however, do not all have the same power to make use of the excreted nitrogen compounds, barley being less efficient in this respect than potatoes. The latter appear to get more benefit from the nitrogen-fixing bacteria than the pea plants themselves. In some cases the growth of the legume seems to have been impaired by the activity of the non-legume in absorbing its excretions. Nowotnowna (Ref. 103) also quotes experiments to show that the efficiency of absorption by the non-legume varies with the species, the available nitrogen from peas being more fully utilized by ryegrass than by barley. On the other hand, red clover and lucerne had no beneficial effect on the growth of barley, while

red clover and serradella (*Ornithopus sativus*) improved the growth of ryegrass, although not so much as did peas. It is suggested that the most efficient use of the excreted nitrogen will result when the period of maximum secretion and excretion of nitrogen by the legume coincides with the most vigorous period of growth of the non-legume growing with it. Experiments conducted by Strong (Ref. 110) have shown that there is also a variation in the effectiveness of the same strain of nodule organism on different host plants, a phenomenon which, Strong claims, is distinct from the varying effectiveness of several strains on the same host.

The practical importance of this work rests, of course, upon the possible absorption under field conditions of nitrogen substances excreted by a leguminous plant. The old idea that the benefit of growing a leguminous crop could be exploited only by the death and decay of its roots in the soil, has been superseded by the view that there is active excretion and absorption while the associated plants are still growing vigorously. The experimental evidence for this hypothesis is described in a general review by Nichol (Ref. 111). Virtanen claims to have shown that there must be a definite numerical relationship between the non-legume and legume plants if the most satisfactory growth is to be obtained. When there are two or more non-legumes to each legume in the mixture, the growth of both species suffers. The association of leguminous and non-leguminous plants is important in both arable and grassland farming, and experimental evidence is now available that benefits are to be derived by mixed cropping in both these spheres. Recent work by Trumble and others (Refs. 112, 113 and 114) in South Australia is directly concerned with the grassland question. Field observations showed that, under certain conditions, the sustained productivity of non-legumes was largely dependent on the presence of suitable associated legumes, but in controlled laboratory experiments with grasses and clovers there was no evidence of benefit to the grass. The investigators conclude that grass gets nitrogen from an associated legume only under certain conditions, viz., where the non-legume is a perennial of extended growth, and the legume is early maturing and quickly passes into a state of senescence. With pastures grown in early summer, however, there was both field and pot evidence that grasses may derive small amounts of nitrogen from a legume, and it seems probable that the water supply to the plants is important in affecting nitrogen excretion and absorption. It must therefore be admitted that evidence for field conditions is still somewhat conflicting, and does not entirely substantiate the results obtained in pot culture experiments.

V.—BARLEY.

Yield and Protein Content of the Grain.

One of the problems confronting barley breeders is how far the total yield of grain is associated with the protein content of the grain. This question is important in breeding for malting quality, and also in connection with the production of varieties, with highly nitrogenous grain, for feeding purposes. In this country high yield is generally associated with a low nitrogen content (which, of course, is an accurate measure of the protein percentage) because the two varieties most commonly grown—Spratt-Archer and Plumage-Archer—are characterised by this association. Hunter (Ref. 115) gives it as his opinion that high ear survival per plant, at harvest, signifies low nitrogen in the grain. He bases his conclusions on experiments conducted at Cambridge in which tillers were removed from plants of the variety Spratt-Archer at different periods of growth. Those plants which suffered this removal of tillers possessed a higher nitrogen percentage than those which were allowed to develop normally, and the nitrogen percentage and thousand-grain weight decreased with the lateness of tiller removal up to flowering time. Manurial experiments with the same variety, in which nitrate of soda was applied at the rate of one hundredweight per acre at various periods of growth, also gave interesting results which apply indirectly to this problem. The dressing of nitrogen was applied at five different times to different plots, viz., at sowing, at the appearance of the first tiller, at erection of the tillers, at flowering, and at three weeks after flowering. Nitrogen added at sowing, at first tiller production and at erection of the tillers, increased the yield primarily by increasing the number of ears per plant, but the nitrogen percentage of the grain was not increased. The later applications increased the yield very slightly (because the size of the grain was enhanced) but the number of surviving ears was not affected, and the nitrogen percentage was considerably increased. These experiments imply that a variety which has the capacity to produce a high number of ears per plant will also yield grain of a low nitrogen percentage, but will not suffer increase of nitrogen content through early applications of nitrogenous fertilisers. Bell (Ref. 116) also found that a variety with a high ear-survival will yield more grain, of a lower nitrogen percentage, than a variety with a low ear-survival. He concludes that the nitrogen content of barley grain is associated with the number of ears per plant at harvest, and with the yield per plant and per ear; he lays stress on the importance of the number of grains per plant in determining the nitrogen percentage.

The question therefore arises as to how far it is possible to produce high-yielding barleys with a high percentage of protein. Honecker (Ref. 117) concludes from his work in Germany that the possibilities are small, because the fluctuation in nitrogen percentage from season to season was greater than between the strains with which he was working. He found certain low-yielding Japanese strains which possessed high protein content; but this character was not inherited and appeared to be due to their susceptibility to the rust caused by *Puccinia simplex*. In order to increase the yield of protein from barley, Honecker suggests that high-yielding barleys should be bred; these will have a low percentage of protein but will nevertheless yield high absolute amounts per acre. Massenbach (Ref. 118) also refers to the higher protein percentage, but lower absolute amount of protein, of Asiatic barleys. He maintains that there is no association between yield and protein content in spring barleys, selection of plants with three or more ears having no material affect on the protein value. Although Massenbach concludes that there are good prospects of breeding spring barleys yielding higher absolute amounts of protein per acre, his experiments suggest that this is not possible with winter barleys.

Neatby and McCalla (Ref. 119) have conducted extensive experiments with wheat and barley in connection with the relationship between yield and protein content of the grain. Because the wheat investigations are directly connected with the questions here being considered for barley, they will be discussed at this point. The experiments were conducted over three years and at eleven different stations in Canada, and included observations on many varieties of both wheat and barley. In all cases the authors found that high yield was associated with low protein content, and they conclude that in wheat and barley "it is certain that there is a genetically controlled association between high yield and low protein." They admit, however, that the degree of this association may vary between strains; for example, the wheat variety Thatcher possesses a relatively high yield and a high protein percentage. The authors suggest that the genetic factors which directly stimulate yield indirectly depress the protein content, and the genetic constitution of a high-protein-content wheat may be due to the accumulation of factors for this character, or to a lack of the high-yield factors accompanied by moderate potentialities towards high protein content.

A consideration of all the foregoing work leads to the conclusion that, although there are many cases in which high yield is associated with a low protein-content of the grain, there are conditions of variety and environment where this does not

necessarily hold good. The closeness of the association is of the utmost importance in the breeding of both wheat and barley. For malting barley and soft wheats the association is to be welcomed, but it is a disadvantage in the production of feeding barleys and baking wheats. It has been shown by wheat breeders in this country that high yield may be combined with high protein content, as for instance in the varieties Yeoman and Holdfast. Research work is now proceeding in this and other countries to find out how far these two characters can be associated in barley for feeding purposes. It is certain that sufficient knowledge has not yet accumulated to allow of any broad generalisations to be made on this subject. In the breeding of malting barley, the material at present being used in some countries appears to show the association of the two desirable characters of high yield and low protein; and it is interesting, in this connection, that the latest Swedish malting barley, Opal B, possesses a greater accentuation of these characters than the original Opal from which it was selected (Ref. 120). But it must be admitted that the possibilities of breaking this association are far from having been fully explored, and new breeding material will probably have to be tried with this object in mind.

Diseases.

Increasing attention is being paid to the study of mildew in barley caused by the fungus *Erysiphe graminis hordei.* Honecker (Ref. 117) reports the occurrence in Germany of nine different forms or physiologic races of this fungus, one of which is alone responsible for most of the outbreaks of mildew. He also reports that a new variety of malting barley has been bred which is resistant to the more important forms and which, in consequence of its freedom from the disease, tends to have a low nitrogen percentage. This is the second reference by Honecker to the effect of the incidence of disease on the nitrogen percentage of barley grain. Tidd (Ref. 121) has studied the reaction of certain American varieties to two new forms of mildew, and found that, in the greenhouse, the seedling behaviour of resistant varieties was very stable, although certain varieties were slightly more resistant in the spring than in the winter. The spring and winter reactions of susceptible varieties were also very consistent; when sown in the winter the adult plant reaction was similar to that of the seedlings but all the varieties were more resistant, in the adult stage, when sown in the spring. Both Tidd, in his investigations with the two new forms of mildew, and Briggs (Ref. 122) in a study of Form 3, found that resistance to fungal attack was a dominant character; but while the former ascribes the resistance to a single genetic

factor, the latter attributes it to two major factors, and possibly other minor factors, in different varieties.

Two well-defined forms of Smut occur in barley, viz., Covered Smut (*Ustilago hordei*) and Loose Smut (*U. nuda*). These two diseases have different life histories and require different methods of control, the former by seed disinfection and the latter by hot-water treatment. In addition to these two common species a third was described some years ago, and has recently been studied by Allison in the U.S.A. (Ref. 123). This species, which is called *U. nigra* or *U. medians*, is intermediate between the other two species, and may have the life cycle of either. It is indistinguishable either from *U. hordei* or *U. nuda* in its effect on the ear, and the only means of deciding whether disinfection or hot-water treatment must be used is to examine the chlamydospores and make germination tests. The forms which behave like Covered Smut produce sporidia, and those that behave like Loose Smut do not. A further complication is to be found in the hybridisation in the field of some forms of *U. hordei* with forms of *U. medians*, resulting in the production of very virulent races. It should be noted, perhaps, that some investigators would not regard as a distinct species the forms which Allison describes as *U. medians*, but would refer to them as hybrids between the Covered and Loose Smuts.

Miscellaneous.

A study of the association of lodging with some anatomical characters of the straw has been made in India by Bose *et al* (Ref. 124). They found that forms which did not lodge possessed a well developed band of strengthening tissue (sclerenchyma) distinct from the strengthening layer immediately under the epidermis, but connected to it at intervals by girders or arms of sclerenchyma. Further, the conductive tissues (vascular bundles) were larger in the non-lodging strains. A study of the inheritance of the two types of anatomy associated with lodging and non-lodging respectively showed a difference based on two genetic factors, the factors for the weaker straw being dominant.

The breeding of winter-hardy barleys is a matter which is receiving attention in this and other countries. A study of two types of frost hardiness may be found in References 125 and 126, in which it is stated that, besides true winter-hardiness, there is a capacity in certain varieties to escape spring frosts by their lateness in starting spring growth. Spring frosts may damage even winter-hardy forms which have started growth, and it should be possible to combine the winter-hardiness of such forms with the capacity of other forms for the evasion of spring frosts, and thus to obtain immunity to all forms of low, temperature damage.

A full description of all the two-row barley varieties commonly cultivated in this country at present, and of those which have been cultivated during the last two decades, is given by Bell (Ref. 127). The paper includes a suggested scheme for identifying and classifying barley varieties according to their ear, grain and vegetative characters; certain characters not hitherto used for this purpose are described. The classification is for the most part based on fairly easily observable characters, and is intended primarily for seed merchants, brewers, breeders and others who handle numbers of varieties.

VI.—WHEAT.

Varietal Spread and Geographical Distribution.

Wheat is an international crop which has spread throughout the world and is grown under a wide range of environmental conditions. Since efforts are being made in many wheat-growing countries to improve the varieties of bread wheats, it is interesting to see how far the improved forms are of purely local value, or to what extent they may spread to other countries and become widespread commercial types. A general account of this aspect of wheat breeding and growing is given by Gescher in Reference 128. Some varieties are cosmopolitan, and are easily adaptable to different environments, while others are more specialised and are suitable only to definite conditions and restricted areas. Again, some wheat-growing countries have had little success with foreign varieties, even though the climate may be similar to that of the country of origin of the foreign varieties in question. Russia, India and Hungary have this difficulty although there are exceptions, *e.g.*, the case of the Australian wheat Aurora, which is grown successfully in Northern Russia as well as in Sweden and Finland. One of the most important factors affecting the successful introduction and colonisation of new varieties is the length of day (photoperiod). This appears to be largely responsible for the failure to interchange English and Australian varieties. Nevertheless, it must be admitted that attempts to explain the known facts in theoretical terms of climatic and other factors have not been very successful.

The history of the migration and introduction of some of the older varieties of wheat, and of the subsequent development of the newer varieties, provides some very important facts for the breeder and cultivator. Some of the more important varieties of the wheat-growing areas of Russia originated in Asia Minor. The varieties Turkey and Kharkoff are of this type. The former was taken to the United States in 1873 and from it were developed varieties which covered millions of acres. Turkey "blood" is

now largely represented by the varieties Kanred and Blackhull. Another example of a successful introduction is Red Fife, which originated in Galicia (Poland) and has been used to breed Yeoman, Federation and Marquis, three varieties of great importance in widely separated parts of the world. It is very significant that some of the most famous wheats in the world today have resulted from hybridising forms derived from distinct geographical areas. The three varieties mentioned above, and others such as Ceres, Prelude, Mentana, Ardito, Aurora, etc., are examples of the success of such methods. In this country, Red Fife and White Fife have been the foundations of the baking quality wheats, while in the United States Red Fife has built up the hard red spring-wheat industry. Some of the South American wheats are derived from Mediterranean parents; the modern Italian wheats resulted from crosses between Mediterranean and Dutch or Japanese forms; Australia is dependent on Russian, Indian, Asiatic, American and other wheats for the development of improved forms; and many other examples could be quoted.

Wheat breeders have thus shown themselves to be very cosmopolitan in their choice of material, and there has been a tendency to utilise forms from the original centres of diffusion. Greater refinement in breeding, within any country, has led to greater specialisation of the improved forms and consequently to a loss of adaptibility. To counteract this tendency the basis of selection of forms for breeding is being widened, although, at present, there are certain strains which have established reputations throughout the world as valuable for breeding purposes. The most important of these are Red Fife (Galicia); Squarehead (England); Hard Red Calcutta and Etawah (India); and Akagomuyhi (Japan). With the exception of Squarehead, these strains owe much of their popularity to their earliness, a character which is of great importance in many of the large wheat-growing areas of the world.

Brief descriptions of four new wheat varieties are given in References 129, 130, 131 and 132. The two Swedish wheats require little comment because they are only higher yielding selections of the two varieties Fylgia and Sol, which have been on the market for some years. Both varieties—Fylgia Élite C, and Sol IV—come originally from crosses with Extra Squarehead (a selection from Squarehead) as one of the parents. The French wheat Côte d'Or is a hybrid variety said to be resistant to cold, lodging and the two rusts caused by *Pucc. glumarum* and *Pucc. graminis* (Yellow and Black Rusts respectively), while it is also high yielding and of good baking quality (Ref. 131). Thatcher wheat is a Canadian variety resulting from a complex cross in which the primary object has been to obtain resistance

to Black Rust. This variety, with Renoun and Apex, has been recently released for cultivation in the hard red spring-wheat areas of Canada. Their milling quality is described in Reference 133, where it is mentioned that Black Rust not only reduces the yield of grain, but also impairs the baking quality.

Diseases.

A general account is given by Macindoe, in Reference 134, of the breeding of wheat varieties resistant to Black Rust. The writer emphasises especially the use of wheats from Kenya in the breeding work in Australia. These Kenya wheats are a new source of rust-resistant forms, and while they are practically immune under Australian conditions, they have also proved highly resistant under other equatorial conditions. In a second article Macindoe describes the use of wheats from different geographical areas for the breeding of a wheat variety with a longer vegetative season of growth, but which is not late maturing (Ref. 135). It is considered that the yield of wheat in certain parts of Australia might be considerably increased by this means.

Apart from the ever-important problem of breeding wheat varieties resistant to Black Stem Rust, breeders and pathologists are also concerned with other important diseases. Loose Smut (Ref. 136), and the attack by the Hessian Fly are being studied; resistance to the latter appears to be associated with an advanced stage of development of the crop at the time the flies emerge in spring (Ref. 137); but more important for the wheat growers in this country are the Root Rots and Yellow Rust (*Puccinia glumarum*). Machecek and Greaney (Ref. 138) have found that scarifying the grain before sowing led to a more virulent attack by the Root-rot fungus *Fusarium culmorum*. Hynes (Refs. 139 and 140), working in New South Wales, found that Root Rot was due to the attack of several fungi, the most important of which were *Helminthosporium M.* (= *Curvularia ramosa*), *Helminthosporium sativum* and *Fusarium culmorum*. Hynes and Garret (see this Journal, Vol. 98, 1937) agree that the fungus *Ophiobolus graminis* is primarily responsible for the Take-All disease, although *Fusarium culmorum* may occur as a secondary invader. Hynes reports six strains of *Oph. graminis* in New South Wales, all of which differ in virulence.

The most important of all the cereal rusts occurring in this country is Yellow Rust, caused by the fungus *Puccinia glumarum*. Bever (Ref. 141) has shown recently that progressively later infections by this fungus produce progressively smaller effects on the plant. Although affected plants suffer a general retardation of growth with a consequent reduction in the yield of grain and straw, the roots are the most susceptible part of the plant and

may be greatly curtailed in their development. Such adverse effects were apparent even in resistant varieties, although there was very little visible infection by the fungus. Owing to the inhibited root growth of the infected plants they used less water than healthy ones, but the former required a greater amount of water than did the healthy plants, to produce a unit of dry matter and a unit weight of grain.

VII.—OATS.

Diseases.

Varietal tests on the relative susceptibility and resistance of some oat varieties to Covered Smut (*Ustilago levis*) have shown that removing the husk of the grain, before inoculation with the fungus, increased the incidence of the disease approximately six times. Although susceptible varieties gave a relatively greater increase in infection than resistant varieties, it would seem that some varieties owe their apparent resistance to the protection of the husk. On the other hand, the investigators of this subject consider that there is enough true resistance among the cultivated varieties for breeding purposes (Ref. 142).

Halo Blight, which is due to the bacterium *Pseudomonas coronafaciens*, and the condition known as Blindness or Blast, the cause of which is not known, were also studied in these investigations. There were differences in varietal susceptibility to both diseases.

Murphy *et al* (Ref. 143) report successful breeding experiments in which resistance to cold, Smut (*Ustilago avenae*) and Crown Rust (*Puccinia coronifera*) have been combined in one variety by hybridisation. In a second paper (Ref. 144) Murphy gives further details of breeding for resistance to Smut and Crown Rust.

There is at present no known variety of oats which is resistant to the ten physiologic races of Oat Stem Rust (*Puccinia graminis Avenae*), but Welsh (Ref. 145) reports hybridisation experiments in which resistance to nine of these races has been achieved, although the two parents (Hajira and Joanette) showed between them resistance only to seven of the races. It was determined that seedling resistance to some of the races was affected by the temperature at which the plants were grown, while at more advanced stages of growth resistance to one race was similarly affected by temperature conditions.

A general description of the factors influencing resistance to frit fly (*Oscinella frit*) is given in Reference 146. It is here stated that there are two forms of resistance, viz., resistance to injury and resistance to infestation. Late sowing increases the susceptibility to injury, while vigorous tillering increases the

resistance. Various morphological and anatomical characters of the plant, such as long and hairy leaf sheaths and well-developed strengthening tissues in the young stems, are associated with resistance to infestation. Similar considerations in relation to frit-fly resistance in wheat are discussed by Chesnokov (Ref. 147), who states that physiological characters such as the rate of development, tillering capacity, rapidity of stem formation, etc., should be studied in analysing the factors involved.

Varieties.

The Welsh Plant Breeding Station has recently released two new varieties of oats suited primarily to cultivation in Wales (Ref. 148). S. 84, which was selected from a cross between the two varieties Victory (*Avena sativa*) and Red Algerian (*Avena sterilis*), is recommended for well-drained soils of high productive capacity. Its most important characteristic is that it is more resistant to lodging, and produces higher yields of finer straw, than Victory. The grain is white, somewhat smaller and of lower husk percentage than Record, which it slightly out-yields. The second of these two new varieties, S. 175, was derived from a cross between the two varieties Black Bell III and Victory. The cross was made with the object of producing an early maturing variety for soils of medium cropping capacity, which would be an improvement on the variety Radnorshire Sprig. The new variety possesses a white grain of a lower husk percentage than Radnorshire Sprig or Record, and its yield of grain is approximately equal to that of the former variety, while the yield of straw is considerably greater. Its greatest defect is a rather low tillering capacity, and it is therefore advisable to increase the rate of sowing by approximately 10 per cent. above that for Radnorshire Sprig.

Robb has conducted experiments in Scotland with two Canadian huskless oat varieties called Liberty and Laurel (Ref. 149). He concludes that these two varieties cannot compete with the standard varieties, but a good huskless oat variety is desirable for poultry and pig feeding. A full description of the registered oat varieties of Canada is given by Derick in Reference 150.

VIII.—GENERAL PATHOLOGY.

The Third International Congress of Comparative Pathology was held in Athens in 1936. Full reports of the papers read on the question of plant immunity to disease will be found in Reference 151. While much of the subject matter of these papers is too academic and technical to be discussed here, students of pathology will be well advised to consult the report, which deals with the nature of immunity to fungal, bacterial

and virus diseases. Coons (Ref. 152) in a general survey of the financial gains due to the cultivation of resistant varieties of some crops in the United States, also gives an account of the more important aspects of pathological research and of the nature of disease resistance. Further articles on the breeding of disease-resistant and immune varieties of plants, and general questions of resistance and immunity, will be found in References 153, 154, 155 and 156.

A more specific problem, and one of direct interest to agriculturists in this country, is that of Chocolate Spot disease of beans. This disease has been ascribed to various causes such as nutrition, bacteria and viruses, but Wilson (Ref. 157) appears to have traced the true cause to the fungus *Botrytis cinerea*, which is distributed everywhere on plant débris. On the other hand, any mechanical injury caused by insects, bruising of the plants' tissues, or frost may be the means by which Chocolate Spot symptoms are developed on bean leaves. Wilson also studied the growing conditions which predispose the bean crop to the fungal attack, and states that waterlogging, sourness of the soil, deficiency of potash and phosphate, winter sowing and a too dense plant stand, are the principal causes. A surface film of water on the leaves is necessary for infection, and the disease develops most successfully in wet seasons when the air is still and the relative humidity high.

Field experiments conducted by Dillon Weston, Hanley and Booer (Ref. 163) have shown that mercuric dusts can give effective control to certain seed-borne diseases of cereals. An experimental dust controlled Loose Smut of oats (*Ustilago avenae*), while Bunt of wheat (*Tilletia caries*), Leaf Stripe of barley (*Helminthosporium gramineum*), Net Blotch of barley (*Helminthosporium teres*) and Leaf Spot of oats (*Helminthosporium avenae*) were effectively controlled by the experimental dust and by a proprietary compound. It is significant also that in some cases the dusting of the grain caused improved germination or an increased plant population. In a separate experiment with green peas, seed dusting with a suitable organic mercuric compound again improved the plant stand and increased the yield of marketable pods in the case of sowings made earlier than March (Ref. 164). It is suggested that this result with peas was due primarily to the protective action of the dust in preventing attacks by soil fungi and other micro-organisms when the conditions were not conducive to rapid germination.

A very valuable and comprehensive review on the subject of soil conditions and the root-infecting fungi has recently been made by Garrett (Ref. 166). The author draws attention to the possibility of the control of soil-borne diseases by management;

agricultural practices can considerably modify the soil environment, which in turn affects the distribution of the disease-producing fungi which live therein. Soil conditions may affect the incidence of a disease caused by a soil-borne fungus either directly, by acting on the fungus, or indirectly by affecting the powers of the plants to resist the fungal attacks. It is considered by some workers that, in general, the more suitable the environmental conditions to the growth of the host plant, the more resistant to fungal attacks will it be. It may happen that an unfavourable environment may simply render the host more susceptible to attack; in other cases the unsuitable soil conditions are the essential cause of a disease, the effect of which is infection by a fungus. Because a pathogenic (disease-producing) fungus must sometimes live in the soil when there is no host plant to attack, the soil conditions are important at all times in affecting the survival of such a fungus. But this does not necessarily mean that the conditions which are most favourable for its survival are identical under both parasitic and non-parasitic conditions; in fact it is probable that the most suitable conditions for its non-parasitic survival are least conducive to the most virulent parasitic activity.

The author deals in detail with the soil conditions affecting the survival and growth in the soil of root-infecting fungi, and he divides them into soil inhabitants and soil invaders. The former are distributed throughout the soil, and they live chiefly on decaying organic matter, becoming parasitic when the opportunity arises. The soil invaders, on the other hand, are primarily highly specialised parasites, and their presence in the soil is generally associated closely with that of the host plants on which they live. To this second group belong the majority of the root-infecting fungi, and these usually die out in the continued absence of the host plants because of their inability to compete with the other micro-organisms in the soil.

Many of the soil-borne diseases have been studied in detail in relation to the particular characteristics of the soil which favour their success in infecting the host plant. Garrett discusses the effect of soil moisture, texture, organic matter, reaction and chemical composition on the incidence of many diseases, and gives tabulated references to the conditions which are said to favour individual diseases. Many of the associations, such as that of Club Root (Finger and Toe) with acid soils with a high moisture content, are well known to most agriculturists, but a selection of the more important cases quoted is given below :—

1. Diseases favoured by high soil moisture content. Club Root; Wart and Powdery Scab of potatoes; Root Rot caused by *Helminthosporium sativum.*

2. Diseases favoured by low soil moisture. Potato Scab; Bunt of wheat; Loose Smut of oats; Covered Smut of oats and barley.

3. Diseases favoured by light soils. Potato Scab and Powdery Scab; Take-all and Bunt of wheat; Clover Root Rot.

4. Diseases controlled by application of organic matter. Potato Scab; Take-all of wheat.

5. Diseases favoured by application of organic matter. Bunt of wheat.

6. Diseases favoured by acid soils. Club Root; Powdery Scab and Wart of potatoes; Covered Smut of barley.

7. Diseases favoured by alkaline soils. Potato Scab; Take-all of wheat.

In a second paper (Ref. 167) Garrett reviews the possible methods of controlling soil-borne fungal diseases. He discusses these methods under two headings: first, the eradication during the resting phase when the host plant is not being grown; and second, the checking of the fungal activity during its parasitic phase on the crop plant. Both types of control are based primarily on agricultural practice and management, and the author draws attention to the impracticability of using toxic sprays for such diseases.

IX.—PHYSIOLOGY.

Controlling Development and Flowering.

The effect of temperature and length of day exposure on the development and flowering of plants has been discussed in previous articles of this series. In these articles it was suggested that the most promising practical results for this country are probably in connection with horticultural crops and flower growing. Gregory (Ref. 158) has recently given a useful general account of how the flowering time of such plants as Cosmos, chrysanthemums, Poinsettia, hardy Salvias, French beans, runner beans, etc., may be affected by the length of light exposure during early growth. Purvis (Ref. 159) describes how, in plants which produce bulbs, the length of light exposure may have no effect, whereas the temperature is of paramount importance. In hyacinths, for example, the temperature during the ripening and storage of the bulbs can control the time of flowering and the quality of the flowers in the following spring. This is because the hyacinth bulb, although apparently dormant, is actively forming new leaves and flowers, and suitable temperature control during storage can stimulate leaf formation and flower differentiation, the latter requiring a lower temperature than the former. For forcing, growth under warm conditions, or early lifting and storage under warm conditions, are necessary.

Experiments by Magruder and Allard (Ref. 160) with onions have shown that the length of daylight exposure affects the maturation of the bulbs. In all the varieties tested an increase in the length of light exposure hastened maturation, but varieties and strains differed markedly in the minimum daylight exposure necessary for bulb formation. There may, however, be variability within the individuals of one variety with regard to their behaviour towards light exposure. An interesting practical consideration is that there is a definite association between the size of the plant at the time bulbing commences, and the size of the mature bulb. It is therefore necessary to have as large plants as possible when the light becomes suitable for bulb formation; this explains the well-known importance of early sowing for successful onion culture.

In cereals it has now been shown that a ripening or developing grain is susceptible to its environment in so far as the plant which develops from it can be affected in its development. Therefore, the so-called Vernalisation of grain, which has been generally practised on germinating material, can be demonstrated on grain before it reaches a dormant condition. Purvis (Ref. 161) has vernalised winter rye by chilling the ears while they are still on the plant, and there appears to be an optimal time between pollination and maturity for the low temperature exposure. Kostjučenko and Zarubaĭlo (Ref. 162) have also studied this aspect of Vernalisation and assert that the so-called physiological, or after-harvest, maturation, which is necessary for successful germination in some plants, may be eliminated by chilling the seed. There is evidence that under-ripe seeds of some plants germinate better than fully mature ones, and in certain cases, such as malting barley, it is known that the germination is improved by short storage. Kostjučenko and Zarubaĭlo have found that seed of the same variety grown under different conditions can produce crops varying in earliness and winter-hardiness; low-temperature ripening induces earlier maturing plants, which are not as winter hardy as those from seed ripened under higher temperatures. The practical significance of this is in relation to seed-producing areas; if climatic conditions can affect the behaviour of the subsequent crop the seed producing areas must be chosen with due regard to the fact.

Bell (Ref. 116) has conducted small-scale trials in this country on the effect of low-temperature grain pre-treatment on some varieties of wheat and barley. No effect was obtained with the spring variety of barley, Spratt-Archer, but marked effects were observed with two winter varieties which are not in general cultivation in this country. These two varieties suffered a marked reduction in tiller production due to the treatment, but the number of surviving ears at harvest was unaffected. The

resulting yields of the two varieties were affected differently by the treatment, one showing a significant reduction, and the other showing a significant increase, in the yield per ear. This alteration in the yield was to be partly explained by the effect on the 1000-grain weight. A similar type of result was obtained with the wheat varieties, in which the yield per plant and the 1000-grain weight were affected, while there was also an effect on the nitrogen percentage of the grain. With the varieties tested, however, it was impossible to increase the gross yield per plot of the vernalised winter forms so that it equalled the yield of the spring forms. It is, however, significant that the quality and yield of grain can be affected in some varieties by low-temperature pre-treatment before sowing.

One of the most recent interpretations of plant growth in general, and of the effects of Vernalisation in particular, is that the plant secretes growth-regulating hormones, in much the same way as animals do. Much of the research work on plant hormones is as yet academic, although there are certain practical applications of considerable importance in horticulture. Chief among these is the stimulation of root growth by the application of synthetic hormones, which are now generally available as commercial products. The subject is, however, a large one and will be reserved for a future article. The immediate point of interest is that attempts are being made to interpret the phenomena of Vernalisation in terms of hormones. (Ref. 165). At present it cannot be said that this interpretation has explained the effect produced on the plant by various Vernalisation treatments, but it has been shown that hormones can affect the rate and vigour of growth and development of plants.

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DISEASES OF ANIMALS: PREVENTION AND TREATMENT.

I.—FOOT-AND-MOUTH DISEASE.

In the early part of 1937 the Foot-and-Mouth Disease Research Committee published its Fifth Progress Report (Ref. 1) covering the work carried out on its behalf from 1930 to 1935. Reference will be made below to some of the Committee's more important practical findings. The problem of foot-and-mouth disease continues to be a source of interest to British agriculture, and in the introduction to the Report the Committee has something to say on the general question of controlling the disease under the conditions existing in this country. One of the main objectives of the Committee, and indeed of workers in other parts of the world, has been to discover a serum or vaccine which would prevent the development of the disease in susceptible farm animals. Everyone who has endeavoured to solve this problem has been faced with the initial difficulty that there are a number of varieties or types of foot-and-mouth virus, and that recovery from an attack caused by one type still leaves the animal more or less susceptible to other types. On the other hand, it has now been ascertained that the resistance or immunity induced by an attack of the disease is strong, and far more lasting than was formerly believed; and this fact is an incentive to renewed efforts to find a practicable method of immunisation. The Committee, however, is careful to point out that, even if a useful vaccine were found, it would be unlikely to supplant the slaughter policy as the main weapon for controlling the disease in this country. A vaccine might, however, be used as a supplementary method, while it

would be of immense value in countries where the disease permanently exists and which export animal products to this country. Widespread use of an effective vaccine in such countries would therefore be of great indirect value to Great Britain. With these considerations in mind, the Committee is therefore pursuing its efforts to find an efficient method of artificial immunisation.

Immunity.

Types of Virus.—Knowledge of the type or variety of virus which is responsible for an outbreak is important for two reasons—firstly because information can sometimes be obtained in this way concerning the source of the outbreak; and secondly because, from the point of view of producing an artificial immunity, it is important to know how many types of virus exist in different countries and their relative prevalence. Actually, the problem of allocating to type those strains or samples of virus obtained from outbreaks of foot-and-mouth disease in farm animals has been pursued for a number of years in this country and abroad, particularly in Germany. In this country, from 1931 till 1934, some material was forwarded to the Committee's station at Pirbright from every outbreak in Great Britain which appeared to be primary, *i.e.* which seemed to represent a separate invasion of the disease. Until fairly recently it was believed that the vast majority of strains conformed to one of three main or standard types, which for certain reasons have been designated the O, A and C types. These types are similar in many of their properties, and they are similar in their visible effects in animals; but they differ in that recovery from an attack by one type leaves the animal more or less susceptible to the other types. Immunity tests of this sort have been carried out on a very large scale both on cattle and guinea-pigs. When guinea-pigs are used, the distinction between the three types is frequently quite sharp, and one gets the impression that the types are quite distinct in nature. On the other hand, when the tests are made on naturally susceptible animals such as cattle, the distinction tends to be less clear-cut, that is to say, recovery from an attack by one type tends to leave the animal somewhat resistant to either or both of the other types. Thus in some extensive tests made in Germany, involving 721 cattle, it was found that three successive attacks, following inoculation of O, A and C virus respectively, could be produced in no more than 11–37 per cent. of the animals, the proportion depending upon the order in which the viruses were inoculated.

So far as the distribution of these varieties of virus is concerned, it is apparent that the O type is the most prevalent. In the Fourth Progress Report of the Research Committee,

published in 1931, it was stated that 63 samples of virus had been received from outbreaks in Great Britain, of which 41 had been examined. Of these only one was shown to be of the A type, while 30 belonged to the O type. During the period covered by the Fifth Progress Report, a more extended examination of strains isolated in this country, or sent from places abroad such as Argentina, Rhodesia and Bechuanaland, has revealed that the distinction between the various types is by no means so rigid as was formerly believed; a considerable number of the strains are intermediate in their characters, that is to say, in their constitution they partake of the characters of two of the standard types. It was also revealed that the A virus is not so rare in this country as had been supposed; of 88 strains tested between September, 1930, and December, 1934, 51 were typed as O, 22 as A, 2 as C, while 13 strains were intermediate in nature. Workers abroad have come to conclusions pointing in the same direction. The intermediate strains are less stable or fixed than are the standard strains. This is shown by the fact that their characters can be made to approach those of one or other of the standard strains by passing them a few times through guinea-pigs. The probable explanation of these character variations, and the description of the methods by which the virus type is arrived at, need not detain us here. It may be noted, however, as an important practical point that, in trying to obtain a vaccine or serum which will be effective against the numerous intermediate strains which exist, it would probably be sufficient to use a few selected standard strains. The search for a reliable vaccine, therefore, is not so hopeless as may at first appear.

Degree of immunity produced by an attack of foot-and-mouth disease.—Apart from the question of the various types of virus, it has been supposed that the transient and relatively slight degree of immunity put up by recovered cattle was an obstacle to artificial immunisation. It has been argued that if resistance is slight after natural infection, there can be little hope of obtaining a powerful artificial resistance. To acquire more information on the point, a large number of cattle and swine at Pirbright have been tested by exposing them in various ways, and after various intervals, to a second infection with the same type of virus as that with which they were first infected. The general result of this work has been to show that the resistance to infection in recovered cattle is very strong, whereas the resistance of swine has been of a much lower order. All the recovered cattle were found to be resistant when they were simply placed in close contact with an infected bovine, or when the test dose of virus was injected into the muscles. When the test was made by injecting the virus into the mucous lining of the mouth, a lesion sometimes formed at the point of inoculation, but rarely else-

where. The details of this work were as follows. Cattle which had recovered from an attack, and were then protected from re-infection, were tested for their immunity by inoculating virus into their muscles at intervals of from 5 to 32 months later and were found to be insusceptible. Cattle similarly treated and tested for their immunity by contact infections were found to be resistant when tested for periods up to 2 years later. Cattle which, after recovery from an attack, had been given several injections of the same type of virus were tested up to 56 months after the attack and found to be resistant. On the other hand, in the case of swine, 10 or 11 months after an attack more than half the animals (13 out of 23) again sickened with foot-and-mouth disease, no matter how the test virus was given. The immunity of cattle for the comparatively long periods named is undoubtedly due to the persistence of virus-neutralising substances in their blood. As a result of these experiments it can be expected that recovered cattle will resist natural infection, with the same type of virus, for several years.

Value of protective serum.—In some continental countries, a protective or so-called hyper-immune blood serum has been prepared for a number of years past. At the German Foot-and-Mouth Disease Research Station on the Island of Riems this serum is made by subjecting cattle to three attacks of the disease by inoculating them in succession with the three standard types of virus and afterwards reinforcing their resistance by further injections of virus. Incidentally, the serum has to pass certain tests for potency before it is issued, and it is probably the best product obtainable. According to the manufacturers, the serum is capable of neutralising the effects of all three viruses, and in Germany and elsewhere it has been extensively used, either alone or in conjunction with virus, for protecting in-contact cattle on infected farms or in the neighbourhood of outbreaks, the object being to prevent the spread of infection.

In the Committee's Report an account is given of some experiments which were made with the Riems serum in order to test its protective value in cattle and other animals. Full doses of the serum were injected into cattle, pigs and guinea-pigs, and the animals were then given one or other of the standard types of virus, or intermediate strains, from this country or elsewhere. Other cattle which had received the serum were placed in contact with cattle infected by inoculation. It was found, however, that even when the serum was given in doses larger than those recommended by the manufacturers, it did not protect cattle or pigs artificially infected or subjected to close contact in a loose box for 24 hours. Some animals, however, escaped infection when the exposure was for three hours only. In the tests on guinea-pigs the results were irregular; generally, the serum gave

little or no protection against the O and C viruses but rather better results with the A virus and certain intermediate types. On the whole, therefore, the results are not encouraging; the serum, as now produced, would have no influence on infections with many of the strains met with in this country.

Since the serum was in large measure powerless to protect animals against direct infection, some attempts were made to test its value against indirect infection, that is to say, its value in preventing animals from acquiring the disease when placed in loose boxes which had been occupied by highly infective cattle for some 24 hours and then left vacant for the same length of time. The results, however, were inconclusive because, for some unexplained reason, the "control" animals (which were not given serum) failed to contract the disease.

Infection of Small Animals and Birds.

The part that small animals and birds, which come into contact with farm animals, may play in the introduction or spread of foot-and-mouth disease has frequently been called in question. It is conceivable that small living creatures may spread the disease, either mechanically by carrying the virus in their intestines, on their feet or body surfaces; or they may act in a still more dangerous way by becoming infected and so actively manufacturing virus. A large number of experiments, briefly referred to below under the particular animal species that have been examined, have been made in order to test these possibilities. It cannot be said that the experiments have afforded any striking proof of the importance of small animals and birds in spreading the disease—any importance they may have must for the present remain to some extent a matter of conjecture—but they have demonstrated that some degree of susceptibility to the virus is widespread in the animal kingdom.

Rats.—Previous experience had shown that neither wild nor tame rats could be infected with certainty by artificial means, though it is now known that susceptibility varies with the individual rat, large and well nourished rats being the most easily infected. In the Fourth Report it was stated that two rats caught on infected premises at Catterick had been found to be affected with foot-and-mouth disease. In consequence of this, a methodical examination of a considerable number of rats caught on infected premises, or at the experimental station at Pirbright, has been made. Between 1929 and 1934 523 rats were tested (all of the kind known as brown rats), 146 of the 523 being from infected premises; 10 of the rats, all from Pirbright, were found to be harbouring virus.

Field Voles.—These animals can be readily infected experimentally and the disease can be transferred from one to another,

quite easily, by inoculation. They do not appear, however, to transmit the disease naturally to one another in captivity.

Hedgehogs.—The experiments which have been made with hedgehogs are of great interest, not only because they can be easily infected experimentally with a severe and fatal form of foot-and-mouth disease, but also because they resemble farm animals in that the disease spreads among them by contact. On one occasion a naturally infected hedgehog was found on a farm in Somerset where the slaughter of cattle had just been completed, and the virus (O) was of the same type as that present in the cattle. Experiments made at Pirbright indicated that the disease could spread from hedghogs to cattle and *vice versa.* Some healthy hedghogs were placed in contact with infected cattle. Four or five days later they were found dead, and virus was present in their blood. A healthy cow was stalled in contact with four infected hedgehogs and as a result she developed a typical attack of foot-and-mouth disease. Recently, E. C. Hulse and J. T. Edwards (Ref. 2) have made the interesting observation that hedgehogs can harbour the virus for a long time when they are in a state of hibernation, and that they can transmit the disease to healthy hedgehogs on awakening.

Dogs and cats.—It was already known that these animals could be infected, especially when they were young. More recently, it has been shown that the disease may spread among them by contact.

Other small animals.—A number of other small animals such as house mice, moles, weasels and rabbits, caught at Pirbright or on infected premises in the field, were examined with negative results.

Birds.—There are statements in the older literature regarding the occurrence of foot-and-mouth disease in fowls and water birds, but these were probably founded on error and they were not supported by experimental evidence. Earlier experiments with birds of various kinds (fowls, ducks, seagulls, sparrows, starlings, martins) had not given any clear indication that birds were susceptible, though the virus occasionally survived in their tissues for several days after experimental inoculation. Nor could it be shown (with fowls or seagulls) that the faeces contained more than traces of virus after the feeding of large quantities of it. Some further attempts in the same direction are described in the Fifth Report. In the case of *ducks*, it was found that, if the virus was injected into the thick pads of skin beneath the toes, infection sometimes resulted and lesions appeared after two or three days, not only at the site of inoculation but also on the upper surfaces of the web. Infection was transmitted through a series of nine ducks in this way and the virus sometimes

appeared in the blood, but the disease did not spread by contact among adult ducks or ducklings. Experiments with *seagulls* were initiated because of the finding, on a farm where foot-and-mouth disease had broken out, of a seagull with foot lesions which were regarded as suspicious. Examination of this bird at Pirbright, however, was unsuccessful in demonstrating virus in it. Ten seagulls were inoculated in the webs of the feet with the virus from guinea-pigs or from ducks. In only one case was a positive result obtained but the infection could not be transmitted to other seagulls and for certain reasons the experiments were discontinued at that point. In general, there was nothing to suggest that seagulls are particularly susceptible to the virus.

Ticks and other insects. A few experiments have been made to see whether such insects as ticks, flies or bugs could transmit foot-and-mouth disease and, although most of the results in this respect were negative, the possibility that the virus might survive in some of these creatures for limited periods was proved. It was decided therefore that more experiments were required with the common tick (*Ixodes ricinus*), which infests cattle and sheep in this country and which is known to be responsible for transmitting redwater of cattle and louping-ill of sheep. The fact that this tick has been found on the hedgehog also lent some colour to the suggestion that it might play a part in spreading foot-and-mouth disease. The experiments referred to were carried out at the National Institute for Medical Research, London. Ticks at the various stages of their life history were allowed to feed on infected guinea-pigs and were then allowed to feed on normal ones, or alternatively their bodies were ground up in a mortar with a little saline and the juice so obtained was injected into guinea-pigs. In neither of these ways could it be shown that the ticks had become infected. In some other experiments with the species of tick (*Argas persicus*) which infests fowls, it was found that virus could survive in the tick for 10–14 days. Transmission experiments by allowing infected fowl ticks to bite normal guinea-pigs, however, were negative.

II.—CONTAGIOUS ABORTION IN CATTLE.

Studies on Vaccination.

Whatever opinion may be held as to the best method in general of dealing with contagious abortion, there would be general agreement as to the value of some form of vaccination in heavily infected herds. The chief attention has been paid to the use of living abortus organisms for the immunisation of cattle, usually prior to service, and such living vaccines have been extensively used in this country and abroad. During recent years, however, opinion has been hardening against the

use of living vaccines, mainly on three grounds: (1) because vaccination is often used in herds where eradication by blood-testing and separation of infected animals would certainly be the proper procedure; (2) because even treatment with living vaccines is not always effective in preventing abortion, and (3) because the organism of abortion, *Brucella abortus*, which, as is well known, tends to become localised in the cow's udder, is capable of causing undulant fever in susceptible human beings. For the last-mentioned reason the use of living abortus vaccines in herds licensed by the Ministry of Health has been prohibited. The case would be met if it could be shown that vaccines consisting of killed abortion bacteria are of value, but unfortunately experience in the past has not been favourable, and some recent work in Germany, to which attention is called below, is in conformity with this experience.

For reasons such as these, many attempts are being made to obtain an efficient system of vaccination with living *Brucella* which would be free from the risks mentioned. These attempts have been made in two directions: (1) the vaccination of calves rather than adult cattle; (2) the use for adult cattle of either dead *abortus* organisms or living ones which have entirely lost their virulence. The term "virulence" denotes the power which some bacteria possess of invading the body and producing disease. In the case of *Br. abortus* this power can be estimated by test inoculations on guinea-pigs.

Vaccination of calves.

This procedure would have a number of advantages, provided it were effective. Firstly, there would be no danger of vaccinating pregnant animals by mistake. Secondly, it has long been known that vaccinated animals give positive reactions to the blood test, just as is the case with naturally infected animals, and this fact may cause a difficulty in herds where, as a means of controlling the disease, the elimination of infected animals is being carried out as well as vaccination. In calves, however, the reactions following vaccination decline much more quickly than in adults. Thirdly, there are reasons for thinking that the danger of the organism becoming established in the body, and particularly in the udder, would be removed. Lastly, the method would be especially valuable for cattle living under range conditions where dates of service are not kept, and where animals are not used to being handled.

Experiments on the use of a living vaccine for calves were announced several years ago in the United States, and are still going on. In 1930 J. M. Buck (Ref. 3), of the United States Bureau of Animal Industry Experiment Station, came to the conclusion that vaccination during calfhood gives an immunity

which is still readily demonstrable in the first pregnancy. Twelve calves which were about five to eight months old were vaccinated and six similar animals were left as controls. Six of the calves were inoculated with a strain of *Br. abortus* which had been isolated eight years previously and which in the interval had been frequently transplanted in the laboratory on artificial culture media, and the other six with a strain which had been isolated only 18 months previously. The culture was injected beneath the skin, and large (probably unnecessarily large) doses were used; in consequence, undesirable swellings formed at the spot, the calves had high temperatures and refused food for two or three days. They were kept apart for three months and then allowed to run with the controls until ready for service. Eleven vaccinated and five control calves remained for further observation. When it was known that all were pregnant, they were fed on two occasions at three-day intervals with naturally infected material, viz., the stomach and intestinal contents of an aborted calf. The result was as follows. The 11 vaccinated heifers produced 11 living calves, all of which, with one exception, continued to thrive for a year or longer. This evidence by itself was insufficient, so in order to ascertain whether infection had occurred bacteriological tests were made of the placenta and colostrum. *Abortus* organisms were grown from the placenta and colostrum of one of the heifers and from the colostrum of another. On the other hand, three of the five control heifers aborted, and *Br. abortus* was isolated from the fœtus and colostrum of each; the two remaining heifers produced vigorous calves, though blood tests indicated that one of the two was infected. The events during the second pregnancy of the vaccinated animals are less interesting because the exposure to the naturally infected material during the first pregnancy would be expected to have enhanced the resistance provided by the vaccine. However, it may be mentioned that the vaccinated heifers were exposed during their second pregnancies, as before, to naturally infected material, that ten of the 11 animals each produced a living healthy calf, while the remaining animals aborted but not through infection with *Br. abortus*. Of five fresh controls (one cow and four heifers) similarly exposed, one aborted, one had a weakly calf near time, one had a dead calf, and the other two, one of which was the cow, had vigorous calves. Abortion bacteria were isolated from the first two mentioned control animals and from one of the two vaccinated animals which had been infected during their first pregnancy. Altogether, only two of the 11 vaccinated animals had *abortus* bacteria in the placenta or colostrum, whereas this was so with five of the ten control animals.

This experiment was most encouraging, so the work was continued by Cotton, Buck and Smith (Ref. 4), who issued a report in 1934 of which the salient features are as follows. Seventeen heifer calves were vaccinated when between four and six months of age and 16 similar animals were used as controls. It was ascertained that 30 of these animals, as judged by the blood test, were free from infection, while three presented slight evidence of infection; a few of the calves were from reacting cows, but these were divided equally between the vaccinated and the control groups. The intention now was to compare strains of *Br. abortus* of different virulence as to their efficiency as vaccines. Hence, the vaccine used for some of the calves was prepared from a strain of very low virulence (as judged by preliminary tests on guinea-pigs), while that for other calves was from a strain of higher virulence. The vaccine was given subcutaneously and the vaccinated calves were kept apart for two months before being placed with the controls. The reactions which ensued were very small, there being a slight rise of temperature and some loss of appetite for a day. Every animal reacted to the blood test after vaccination, but the reactions had declined considerably four or five months later. All the animals were put to the bull at 18 months of age, when 11 of the 17 no longer gave any reaction to the blood test; the others reacted only very slightly, indicating that at that time none of them was a carrier of *abortus* bacteria. As soon as it was known that all were pregnant, they were exposed to infection by dropping on the eye-ball a little *abortus* culture—a method which is known to be a certain way of transmitting the disease. As a result, all 33 animals again reacted to the blood test, but, whereas in the vaccinated animals the reaction declined and was negative or slight three months later, in the control animals the strength of reaction remained the same or increased. This indicated that in the former the infection set up by the test inoculation in the eye was transient, whereas in the controls it tended to be permanent. From the first pregnancy 16 of the vaccinated heifers produced vigorous calves and one produced a weakly calf. Bacteriological examination showed that this one heifer was carrying *abortus* organisms in its uterus and colostrum, and that one of the others was similarly infected in the colostrum. Of the 16 controls, seven aborted and three produced weakly calves; *abortus* bacteria were found in the uterus and colostrum of eight of the ten, while the two others could not be examined. The remaining six control heifers gave birth to vigorous calves, but two of them were carrying *abortus* organisms—in the uterus and colostrum in one case and in the colostrum in another. Ten of the vaccinated animals were observed over a second pregnancy and,

in order to test whether their infection still persisted, they were placed, together with controls, in contact with infective cows. All the vaccinated cows produced vigorous calves, but unfortunately for some reason none of the control animals acquired the disease. These experiments again indicated that by vaccination during calfhood an immunity is produced which is still demonstrable during the first pregnancy, and moreover it seemed that a culture of low virulence was as useful for vaccination purposes as one of pronounced virulence.

The possibilities of calfhood vaccination have been tested in the United States in other and smaller experiments than those just referred to, and these have indicated, in general, that some protection can be obtained in this way. At the moment it can be said that the results are encouraging and that the method deserves to be tried out on a larger scale under natural conditions. This, in fact, is now being done by the Bureau of Animal Industry. According to statements in the literature, observations are under way in 220 herds, containing about 16,000 cattle, and in these about 2,400 calves have already been vaccinated.

Vaccination of adult cattle.

Dead vaccines. As stated previously, most people who have studied the subject have come to the conclusion that vaccines consisting of killed abortion bacilli have little or no value in preventing abortion. From time to time, however, claims are still being put forward on behalf of some new dead vaccine, usually on the ground that the organisms have been killed by some special process involving the use of a chemical which is said to have preserved the immunising quality of the culture. A case in point occurred in Germany within recent years and the matter was investigated officially at the Government Research Station near Berlin by Zeller and Stockmayer (Ref. 5). Three special vaccines were tested, these consisting of *abortus* cultures killed (*a*) by a disinfectant known as " chinosol " ; (*b*) by iodine ; and (*c*) by the dye known as methylene blue. For comparative purposes a vaccine composed of cultures killed by low degrees of heat was tried. The experiments were pursued for two years, 32 healthy pregnant heifers being used, six animals for each of the four vaccines and eight as controls. Three doses of vaccine were injected into each beast at intervals of a fortnight. Four weeks after the last dose all were given living abortion bacilli. As a result, most of the animals, both vaccinated and controls, aborted, and some proved to be sterile when again put to service. On the whole, abortion was a little delayed in the vaccinated animals and sterility was slightly less common, but neither of these effects, of course, made any of the vaccines of practical value.

Living vaccines. It is quite well recognised that *Br. abortus* is too dangerous to be used as a vaccine shortly after being grown from an aborted foetus or from the genital tracts of aborting cows. But when such strains are repeatedly subcultured, *i.e.*, transplanted a number of times in artificial culture media in the laboratory, they lose much of their virulence, so that in the opinion of many they can safely be used as vaccines provided they are injected into non-pregnant animals not less than two months before service. Other investigators, however, have contended that even cultures of reduced virulence should not be used, and have therefore endeavoured to see whether cultures which have lost *all* their virulence would be of value for immunisation. In what follows it is proposed to refer to some of the work which has been carried out with live vaccines during recent years.

The fact that a strain of *Br. abortus* so reduced in virulence that it was incapable of causing disease in guinea-pigs, except when used in very large doses, could still induce in cattle a high degree of resistance was shown in 1925 in the United States by the late Dr. E. C. Schroeder in company with W. E. Cotton (Ref. 6). In order to get any important degree of protection, however, the vaccine had to be used on cattle which were already pregnant. Since 1925, experiments on the use of live vaccines—either non-virulent or of low virulence—have been continued by various workers in the United States. Cotton, Buck and Smith in 1933 (Ref. 7) used as a vaccine a strain of *Br. abortus* which had been isolated in 1915 from the milk of an infected cow and which in the interval had been subcultured some 180 times. The strain was then incapable of producing disease either in guinea-pigs or cattle. In testing the value of this culture as a vaccine, ten pregnant cattle (three cows and seven heifers) were injected subcutaneously and 1–2 months later were exposed, together with nine unvaccinated pregnant cattle, to infection with virulent *Br. abortus*, the culture of this organism being dropped into the eyes or given by the mouth, or given by both routes. The result of the experiment was that three of the vaccinated animals aborted, three had weak calves and four animals only had vigorous calves. Of the nine controls, seven aborted and only one of the other two produced a vigorous calf.

This experiment indicated that a vaccine prepared from a non-virulent strain of *Br. abortus*, administered during pregnancy, cannot be relied upon to confer a pronounced immunity, though it certainly had some protective effect. From this and further work Cotton, Buck and Smith concluded in 1934 (Ref. 8) that *Br. abortus* can become so altered by repeated subcultivation that its immunising power disappears. If, on the other hand,

the organism is merely reduced in virulence by subcultivation, a point is reached, according to the authors, at which it is practically free from danger when tested on non-pregnant cattle, but still retains an immunising power quite as high as that of a much more virulent strain. In support of these conclusions, two experiments are quoted. Only one of these need be referred to here since both experiments gave similar indications.

Three groups of cattle, containing eight, nine and eight animals respectively, were used. The first and second groups were vaccinated before service with non-virulent and low-virulent cultures respectively, while the third group served as a control. Soon after the animals were pregnant, some virulent culture of *Br. abortus* was dropped in the eye, and the results were as follows. In the three groups the numbers of animals aborting (proved due to *Br. abortus*) were two, one and eight respectively, and the numbers resisting infection were three, five and none. The test of immunity was obviously a severe one, since all eight controls aborted. Although the numbers are small, the indication clearly is that the strain of low virulence was superior, as a vaccine, to the non-virulent one.

Now it must be pointed out that, while cultures of low virulence may have their advantages for immunisation, it is not easy to be sure that the virulence of a given culture has been reduced to the right degree. Also, so long as cultures have *any* virulence there must always remain some doubt as to their safety. Moreover, it does not altogether follow that, because the particular non-virulent strains used by Cotton and others were of poor value, non-virulent strains capable of giving good protection cannot be found. For such reasons workers have not ceased their efforts to obtain living vaccines which are entirely devoid of virulence and which could, if necessary, be used with safety on pregnant cattle. I. F. Huddleson (Ref. 9) at the Michigan Agricultural Experiment Station and A. D. McEwen at the South-Eastern Agricultural College, Wye, Kent, have both experimented with non-virulent strains. With Huddleson's vaccine it appears to be doubtful whether the immunity conveyed is great enough in practice. McEwen, in collaboration with R. S. Roberts (Ref. 10) made preliminary experiments on guinea-pigs. They found, as had Schroeder and Cotton previously, that these animals are suitable for this work because *Br. abortus* invades the pregnant uterus, often with abortion as a result and sometimes with abscess formation. The vaccine strain used by McEwen and Roberts was isolated prior to 1922 and had entirely lost its virulence for guinea-pigs. When female guinea-pigs were inoculated with it before conception, and then exposed to an active strain of *Br. abortus*

during pregnancy, it was found that the virulent test strain was prevented from invading the uterus although it might still produce lesions in other parts of the body. The value of the vaccine was also shown in experiments on male guinea-pigs, which could be rendered more resistant to infection. The resistance was found to last for at least nineteen weeks, this being the longest period tested. Since it seems that the non-virulent strain cannot survive in the body for more than three weeks, it can hardly be, as has been supposed, that resistance depends upon the persistence of the vaccine strain in the body. Finally it was noted, in a few cases, that vaccinated animals showed little more, or no more, resistance than controls. This is an observation of great interest and importance, as indicating that, just as guinea-pigs vary from time to time in their "immunisability" (power of responding to a vaccine), so also may cattle. The reasons for such a variation are unknown but are perhaps in some way connected with the nutritional state of the animal, which in turn may alter from one season of the year to another.

As soon as the value of the vaccine had been established in guinea-pigs, McEwen (Ref. 11) proceeded to make tests in cattle. In the first place, of course, it was necessary to make sure that the vaccine was safe, and the following experiments indicated that this was the case. Fourteen cattle belonging to a herd where natural cases of abortion disease were occurring, but which were themselves non-infected as judged by the blood test, were inoculated subcutaneously with very large doses of the vaccine. The strain, however, failed to become established either in the uterus or the udder. In most of these animals two or three inoculations were given before service and three or four inoculations after service up to some three or four months before they were due to calve. Two of the animals were heifers carrying the first calf and these were inoculated with a single massive dose—600,000 million organisms—but both calved normally and the fact that neither gave an appreciable reaction to the blood test suggested that they were not infected. Later, ten heifers, three to five months pregnant, belonging to a non-infected herd, were each inoculated subcutaneously with 36,000 million organisms; they did not abort nor could *Br. abortus* be found in their colostrum or in the foetal membranes when these were available. On one occasion a very large dose was injected into the blood of three pregnant heifers; this caused an infection of the uterus which, judging by the continued low blood reaction, was transient, and two of the animals aborted. The vaccine strain was recovered from one of the foetuses, but it was still incapable of infecting guinea-pigs.

On the basis of these findings it was decided to test the vaccine in infected herds. In these herds no other attempts were made to control the disease (*e.g.*, by isolating infected cows) while the value of the vaccine was judged not only by its power of preventing abortion but also by its effect on the blood reaction and its ability to prevent infection of the uterus and foetus, and of the milk. A start was made in 14 herds (847 cows) but for various reasons not more than eight herds (501 cows of which 163 were infected) could be followed beyond the first year. The vaccine was applied subcutaneously and only to uninfected animals, that is, only to animals which did not react to the blood test. Non-pregnant animals were injected and also pregnant animals, provided they were not due to calve within two months. The exact procedure varied, but the aim was to give three doses of vaccine at intervals of about two months, and another dose after calving. After vaccination the blood reaction tended to remain low, provided the animal had not acquired a natural infection, so that the blood test could be used as the guide as to whether revaccination should be practised or not.

McEwen supplies interesting figures by which the effect of the vaccination in the eight herds may be judged. In connection with other work on contagious abortion there had come under the supervision of the Veterinary Department at Wye College 50 herds with 2,045 cows. Of these 518 (25 per cent.) gave positive reactions to the blood test and 179 (eight per cent.) gave suspicious reactions, most probably indicating infection. Of 1,288 pregnancies in uninfected animals, 57 (4·5 per cent.) ended in abortion, presumably due to causes other than *Br. abortus* ; of 757 pregnancies in positive or suspicious animals, 239 ended in abortion. Since it may be supposed that 4·5 per cent. of the 239 abortions were not due to the organism of contagious abortion, *Br. abortus* could be said to be responsible for an abortion rate of about 11·0 per cent. in the 50 herds. When all the pregnancies among vaccinated animals in the eight herds are considered, 2·9 per cent. of them terminated in abortion due to *Br. abortus*. Since, however, among the animals vaccinated during the first year there were probably included some which were naturally infected although reacting negatively to the blood test, it is better to exclude from consideration animals vaccinated in the first year. In succeeding years only 1·1 per cent. of the pregnancies among vaccinated animals terminated in abortion and this figure is to be compared with that of 11·0 per cent. given above. In only two of the eight herds was it possible to keep uninfected animals which would serve as unvaccinated controls. In these two herds the abortions in the vaccinated and control groups, over the three years'

experiment, amounted to 1·1 per cent. and 8 per cent. respectively, but during the second and third years the figures were 1 per cent. and 10·5 per cent. respectively. These results, then, provide direct evidence of the good effect of vaccination.

McEwen's work provides a good example of the difficulties and disappointments of the research worker who is compelled to make observations in commercial herds where of course the movements of animals are not under his control. In order to meet difficulties of this sort, the Agricultural Research Council has recently acquired a field station where experiments on farm animals, of the type just considered, can be carried out under natural conditions and under proper control.

Schemes of Eradication.

At the present time the only system by which real control over contagious abortion can be exercised is by the use of the blood test, accompanied by measures designed to prevent the disease from spreading to healthy stock. If this instrument is to be put to effective use State action is required and the feasibility of this will depend on a number of factors, such as the incidence of infection in the country generally and the regional distribution of the disease, the extent of livestock movement and, last but not least, the attitude of the agricultural community towards livestock sanitation in general. In the present section of this article some indication will be given as to what is proposed or is being done in those countries for which the information is available.

In Great Britain the problem is considered to be one of special difficulty, mainly owing to the wide prevalence of the disease, but action is promised under the Agriculture Act of 1937 as soon as the plans for dealing with tuberculosis have made more headway. In Denmark, Hungary, Germany and Switzerland voluntary schemes of control are in existence, of which stock-owners are encouraged by government to make use. In Switzerland, for example, free testing of herds is provided, State assistance is furnished to owners requiring healthy cattle for replacements, and official recognition is given to abortion-free herds. The use of vaccines is prohibited in herds included under the scheme except where the incidence of infection reaches 70 per cent. or more. In Norway a new eradication scheme was put into operation at the beginning of 1935, and already this scheme is reported to have made great and unexpected progress. During 1935, 6,207 herds were tested and 2,278 of these were found to contain reactors. 10,500 reactors were removed and 8,655 of them slaughtered, with compensation to the owners. In a report for the year 1936 it is stated that 2,741 herds had been found to contain reacting animals and by the end of the

year 2,073 (75 per cent.) of these were regarded as free. There remained 321 infected herds, or 11·7 per cent. of all herds originally infected.

Very substantial progress in eradicating abortion has been made in the United States, where a so-called co-operative plan was initiated in 1934. Measures for controlling abortion had been adopted in many States for a number of years, but the present plan grew out of a scheme for reducing the cattle population of the country, and funds for it are provided partly by the Federal Government and partly by the individual States. So far as the Federal Government is concerned, the plan is still a voluntary one and, although for the time being it is mainly concerned with eradicating the disease from individual herds, in certain districts where the degree of infection is not high, and where public sentiment is favourable, arrangements are being made to clean up areas of country. Incidentally, farmers in the United States can be said to have become "disease-eradication minded," and contributing factors to this attitude are stated to be the wide publicity given to animal disease control and the confidence which has been inspired by the success of the tuberculosis eradication scheme.

From the large amount of blood-testing which was carried out in the United States prior to 1934, it was believed that the average incidence of infection among cattle could be put at about 15 per cent., and this has been borne out by the tests conducted under the present scheme. Under the plan reactors are slaughtered with compensation, and this is followed by cleaning and disinfection of the premises. The owner has then to agree to adopt a certain procedure designed to prevent reinfection and, in most States, he is then given a certificate to denote that his herd is "accredited." In herds where infection is found, a maximum of two and later of four tests are made at stipulated intervals, but testing is stopped as soon as two consecutive negative tests are obtained.

Up to November, 1935, tests had been made of over 5 million cattle in some 340,000 herds, and 531,000 reactors had been eliminated; about 35 per cent. of the herds contained some infected animals. As some indication of the financial outlay involved, it may be stated that for the year ending June, 1937, over fourteen million dollars were made available by Congress, and some States voted additional money from their own funds. The future of this campaign against abortion will be followed with interest by persons in other countries who are concerned with animal disease control. So far, the campaign appears to have proceeded comparatively smoothly but two problems have caused some difficulty, viz., the interpretation which should be given to doubtful or suspicious reactions to the blood test,

and the problem of guaranteeing that additions to tested herds are sound in health.

III.—THE CONTROL OF BOVINE TUBERCULOSIS.

Bovine tuberculosis continues to be the animal scourge in which public health authorities are mainly interested, and efforts of some kind—to be briefly referred to below—are being made to deal with it in most cattle-raising countries.

GREAT BRITAIN.

In Great Britain measures for dealing with tuberculosis have been provided at one time or another by the Tuberculosis Orders of 1913, 1925, 1936 and by the Milk (Special Designations) Orders of 1923 and 1936,—all of which are concerned with protection of the milk supply rather than with the disease from the agricultural standpoint. In the past, schemes for wholesale eradication were formulated from time to time, e.g. that of the Scottish Branch of the National Veterinary Medical Association in 1929; but for various reasons no action was taken. In 1935, however, the Government put into operation the Attested Herds scheme, which lays down very rigid regulations for the tuberculin-testing of approved herds, for eliminating reactors and for preventing reinfection, and which provides financial inducement in the form of a bonus payment on milk sold through the Milk Marketing Boards. During 1937, however, these regulations were amended so as to give owners additional financial inducement to eradicate the disease and assistance in taking the preliminary steps towards eradication; in this way progress has been facilitated. More recently still, the financial assistance has been extended to beef-producing herds by means of a capitation grant. The Ministry of Agriculture issues periodically a Register of Attested Herds; up to 30 June, 1938, there were in England, Wales and Scotland 2,681 attested herds with 141,241 animals, the counties with the largest numbers being Ayrshire and Carmarthen.

Under Part IV of the Agriculture Act, 1937, the Government now proposes, as part of its plan for cleaning up the herds of the country, to make a survey of self-contained herds—both milk and beef herds—in Great Britain, in order to find out where they are located and then, by means of the tuberculin test, to determine the incidence of tuberculosis in them; in this way will be found those areas in which eradication should be attempted—at first on a voluntary basis and then by the use of compulsory powers. In this connection it is fitting firstly to refer to an experiment on eradication which was conducted in Ayrshire in the period 1929 to 1932 and secondly to consider some recent attempts which have been made to estimate the incidence of tuberculosis in certain districts of Wales or England.

The Ayrshire experiment was promoted by the Medical Research Council and was carried out from the Hannah Dairy Research Institute by the pathologist-in-charge, Dr. L. Jordan. A full report was issued in 1933 (Ref. 12). The object was to determine the extent to which tuberculosis could be eradicated from a group of dairy herds by providing the owners with free tuberculin testing and free veterinary advice on the isolation of reactors and the rearing of young stock. The plan was based essentially on that first recommended in Denmark by the late Prof. B. Bang, which consisted of the gradual replacement of reactors by young healthy stock or other clean animals. An area of country of some nine square miles, and containing 37 typical dairy farms, was selected. Thirty of these farms (780 cows), all of them self-contained, participated, and 22 of these had never been tested previously. The aim was to eradicate the disease from this area with the minimum of disturbance to farm routine. Thus, reactors were kept until after the next calving and then sold, while calves were reared on the milk of non-reactors. Reactors and non-reactors were housed separately if possible, otherwise at different ends of the same building; separate pastures were provided, and such other measures were adopted as might be necessary to prevent infection of healthy animals. The herds were retested every six months during the three-year period over which the plan was allowed to operate. Very few animals were bought in, and these were allowed to enter the area only if they had passed the tuberculin test. At the first test of 1,475 animals, 385 (26·1 per cent) reacted, but eight herds were found to have no reactors. Incidentally, it is of interest to note that out of 636 reacting animals, none of which was showing symptoms of the disease, nine (1·4 per cent.) were excreting tubercle bacilli in the milk. Out of the 30 herds participating 28 made substantial progress; 20 were free from infection at the end of the experiment and the remaining eight showed marked reductions in the numbers of reactors. During the same time, two herds, in which no consistent efforts at control were made, showed an increased incidence of disease. During the three years there was noted a general improvement in the health of the stock, leading to an appreciation of their value and an increased demand for them. The costs incurred were small, and were more than offset by the higher value of the stock.

At the conclusion of the experiment it was thought by some that, with the cessation of free testing, a large proportion of owners would make no further effort to keep down the disease, and that, in consequence, the good results achieved would be found to be transient. It was decided, therefore, $2\frac{1}{2}$ years after the cessation of free testing, to retest all the herds and also to find out what influence the experimental scheme had had on

the herds of neighbouring districts. The results of this retest have now been published by S. J. Edwards (Ref. 13). It was found that in five of the 30 herds there had been no consistent improvement, partly through lack of enthusiasm among the owners and partly because of poor facilities for isolation. In the remaining 25 herds, however, further substantial progress had been made, 24 being free from infection—16 of these were officially recognised as tubercle-free—and one other practically free. After the $2\frac{1}{2}$ years' break, 1,372 animals in these 25 herds were tested; only 15 (1·0 per cent.) reacted, and the young stock were completely free. As to the herds immediately surrounding the area, enquiry showed that many of these (64 out of 192) were free from the disease and that 37 of the remaining 128 had taken initial steps towards eradication. The evidence indicated that this state of affairs had been brought about largely as a result of the good example set by the farmers in the experimental area.

Incidence of the disease in Great Britain. As to the way in which tuberculosis is distributed over the cattle population of this country, there is at present little precise evidence. It is usually accepted that 40 per cent. would be a reasonably correct estimate of the average incidence among cows in dairy herds and that in the essentially beef-producing herds there is less infection. Some information on these points can be obtained from abattoirs, but this is somewhat misleading, mainly because it is liable to refer to selected groups of animals such as old cows, steers or young calves. In order to obtain a true estimate, the only way is to apply the tuberculin test at random to a considerable number of animals of all ages and both sexes. A noteworthy attempt in this direction was made by R. F. Montgomerie and W. T. Rowlands (Ref. 14), who, with the co-operation of owners and veterinary practitioners, tested all the cattle, except those under two months of age, in four cattle-rearing districts, chosen at random, in North Wales. On the great majority of the farms in these districts no previous tuberculin tests had been made. 2,270 cattle on 101 farms were tested and only 113 (5 per cent.) reacted. On 57 farms no reactors were found and on 15 others all the home-bred stock were clean. The relative freedom of these herds was all the more surprising when the poor conditions under which most of the animals were kept were borne in mind. It is well known that there is less tuberculosis among young than among old animals, and in this case just over 70 per cent. of the animals were under three years old; but even so, 5 per cent. is a low incidence. In the animals over three years old, 647 in number, the incidence was still only 10·2 per cent. The reaction rate in the four districts varied from 1·4 to 11·8 per cent. and seemed to depend

largely on the age to which the cows were kept and on whether calves were home-bred or were purchased from dairying districts. This difference in respect of the calves was very noticeable in the first district where, out of 65 purchased calves under one year old, 18 per cent. were tuberculous, while 93 home-bred calves of the same age gave only 3·2 per cent. of reactors.

It has often been maintained that Hereford cattle, for the reasons that they are of beef breed and lead an open-air life, are relatively free from tuberculosis. Recently, A. J. Wilsdon, the County Veterinary Officer of Herefordshire, has made some observations on the incidence of the disease in the breed's home County (Ref. 15). 1,216 cattle belonging to 15 farms, and considered to be representative of the beef cattle of the County, were tuberculin tested, and only 34 (2·8 per cent.) reacted. 473 of the animals were cows and even among these the reaction rate was only 5·7 per cent. Eight of the fifteen farms carried no reactors and on only two did the incidence exceed 11 per cent. Tuberculin tests were also made of 1,737 previously untested cattle, all of them over six months of age, belonging to 50 dairy herds situated in every part of the county. As a result, 411 (23·7 per cent.) reacted, a figure which is still well below the generally accepted average for the country as a whole; moreover, one-half of the herds showed an incidence not exceeding 15 per cent. Of the 1,737 cattle, 1,127 were cows and of these 324 (28·7 per cent.) reacted. Wilsdon suggests that the proportion of cattle in Herefordshire reacting to the test can be put at about 9 per cent. and that it would be still lower but for the increase in milk production and the change in the system of farming which have taken place during and since the War. He holds that the greater part of the county is, at the present time, suitable to be declared an Eradication Area under the Agriculture Act, 1937.

These small surveys go to show that in essentially breeding and beef-producing districts the amount of tuberculosis is likely to be low, and that a policy of wholesale eradication need not be unduly delayed because the incidence figure in dairy herds is put as high as 40 per cent. Further, the importance of protecting the breeding districts from the purchase of infected calves through markets is emphasised by the results of the North Wales enquiry.

Frequency of tuberculin testing. In a recent article (Ref. 16), Sir John Kelland, J. L. Frood and T. M. Doyle, of the Ministry of Agriculture, have given an account of a large and extremely well-kept herd of 200 cows in which eradication of tuberculosis had long been attempted. Efforts in this direction were begun in 1917, tests being made every six months, but in spite of all precautions the disease was not eliminated. In 1934 the owner

approached the Ministry; the herd was taken over and the tests were applied every two months, with the result that completely negative tests were obtained in less than two years, and the owner was then able to obtain an Attested licence. Before 1934, the testing had been carried out by five different veterinary surgeons, all of whom were competent men with long experience of the work and who, in their anxiety to eradicate the infection, were probably at times unduly severe in interpreting the tests. When all the facts are considered, Kelland and his colleagues are forced to the conclusion that the main cause of the previous failure to eradicate the disease was simply the long interval between tests. They point out that, while six-monthly testing undoubtedly keeps the disease at a low level, and provides considerable protection to the public against tubercle bacilli in the milk, testing at much shorter intervals is necessary if eradication is to be achieved. The advantage of the short intervals is that reacting animals do not have time to communicate the disease to their healthy companions. Such short interval testing would also, of course, benefit the owner by reducing greatly the incidental expenses.

The Channel Islands.

In Guernsey special regulations have been in force for some years and have had the effect of reducing the disease to negligible proportions. The entrance of live cattle is prohibited, animals for export have to pass the tuberculin test, there are restrictions on the movement of cattle within the islands and slaughter of reactors is compulsory, with compensation to the owners. In Jersey similar methods have been adopted, and the island is believed to have been free from the disease since 1914.

Other European Countries.

In France new laws for dealing with tuberculosis were passed in 1933. These make provision for a voluntary scheme which owners are encouraged to enter by the offer of State grants. The scheme involves veterinary examination of the cattle, tuberculin testing, elimination of reactors, disinfection of premises and registration of all herds found to be free, *i.e.*, which have passed two consecutive tests without reactors.

In Germany also voluntary schemes, financed partly by the State and partly by the owner, are in operation. These are based in part on what is known as Ostertag's method of control, which consists of the detection and prompt removal from the herd of all so-called "open" cases, *i.e.*, animals which are actually excreting the bacilli and so are the most dangerous spreaders. Another measure is the protection of calves, which must be fed on boiled milk or on the milk of healthy cows. In

1936 it was reported that out of a total of 45,954 herds 37 per cent. were free, 9 per cent. were lightly infected and 53 per cent. heavily infected. Most of the large herds contained tuberculous animals.

In Denmark the law requires that cows with tuberculosis of the udder or uterus shall be slaughtered and that skim milk or butter milk returned from dairies for calf or swine feeding must be pasteurised by the " flash " method. In addition, the State gives assistance in semi-voluntary measures founded on the use of the tuberculin test. In Sweden much the same system has been adopted, and the voluntary scheme is apparently meeting with considerable success.

The United States and Canada.

The most outstanding results in the matter of control have been achieved in the United States. In that country a co-operative plan, in which Federal and State veterinarians take part, was started in 1917 and is now operative in practically the whole of the United States. The progress which had been made up to 1929 was set out in " Agricultural Research in 1929 " (Ref. 17) and that article should be consulted by those who are interested in the earlier stages of the campaign. The main features of the plan are tuberculin testing, the early slaughter of reactors and disinfection of the premises they have occupied. At first, attention was paid to cleaning up individual herds, but this procedure has been replaced, wherever possible, by a campaign on a regional or area basis; in this an attempt is made to create " modified accredited areas " where the incidence of the disease has been reduced below 0·5 per cent. In such areas all or part of the cattle must be tested periodically. In time, herds or areas become "fully accredited," a term which implies that all the animals have passed two tuberculin tests with an interval of a year, or three tests at intervals of six months. The retesting of fully accredited herds later has shown that only about 5 per cent. of them contain any reactors. A test of 134,143 cattle in 1918 showed that 6,544 (4·9 per cent.) of them were reactors. Since then the numbers tested have constantly increased and now several million tests are held annually.

The position of the campaign has recently been set out by A. E. Wight (Ref. 18), who is Chief of the Tuberculosis Eradication Division of the Bureau of Animal Industry. During the year ended June, 1936, nearly 23 million tuberculin tests were carried out and 165,000 reactors (0·7 per cent.) were found, this percentage being about half that of the previous year. Most of the testing is now being done under the area plan. On October 1, 1936, there were 256,000 fully accredited herds,

(about 3,750,000 cattle). An outstanding event during the year ended June, 1936, was the inclusion in the modified accredited area of Texas, the largest State in the Union and the one with the greatest cattle population. By the spring of 1936, 41 of the 48 States were in the modified accredited area, and it is expected that within a year all but one or two of the remainder will be included. Other points indicating the extent of progress are as follows. At the end of June, 1935, the total number of cattle under official supervision was nearly 49 million out of the country's total cattle population of about 65 million head. Since 1917 the total number of reactors removed has been 3,302,561. Every two years a survey is made to determine the approximate extent of bovine tuberculosis in the United States. The first of these surveys, made in 1922, indicated that about 4·0 per cent. of all the cattle in the country were affected, though in some States the proportion was very much higher. The eighth survey, completed in 1935, indicated that the incidence had been reduced to 0·6 per cent.; that in only nine counties, in two States, was the infection higher than 7·0 per cent.; and that in only four counties, in two States, was it more than 15 per cent.

As would be expected, the campaign has had a big effect on the number of carcases seized in the abattoirs on account of tuberculosis. During the fiscal year ended June, 1936, about 10 million cattle were slaughtered under Federal inspection and of these only about 19,000 (0·19 per cent.) showed any evidence of the disease. These figures do not include known tuberculin reactors. Of the carcases showing any infection, only 4,800 were condemned as totally unfit for food, or about 0·05 per cent. of the total cattle slaughtered under Federal supervision. The figure 0·19 per cent. is to be compared with that of 2·3 per cent. in 1916, when between seven and eight million cattle were slaughtered. The percentage of carcases showing tuberculosis has, in fact, been falling practically continuously since 1917. The campaign is now also showing its effect on the number of hog carcases that are condemned. The abattoir examination forms an important branch of the eradication scheme because, when cattle or swine from a modified accredited area are found to be affected, attempts are made to trace the source from which they came.

In Canada a plan similar in principle to that of the United States was started in 1919, though other schemes had been in operation prior to this. Two results of the present campaign may be mentioned by way of illustration. About 30 per cent. of all cattle in the Dominion are now under official supervision. The proportion of tuberculous carcases in the packing stations has fallen from about 7·5 per cent. in 1925 to about 2 per cent. in 1935 (G. Brook, Ref. 19).

IV.—DISEASES OF ANIMALS CAUSED BY FILTERABLE VIRUSES.

Filterable viruses, it should be recalled, are living agents which are, for the most part, so minute that they cannot be seen with the highest magnifying powers of the microscope and are capable, largely on account of their small size, of passing through the pores of special filters which arrest the ordinary or microscopically visible bacteria. At the present time, filterable viruses are recognised as the cause of a great number of diseases in human beings, animals, birds, insects and fish, as well as in plants, and it seems that even bacteria are liable to be attacked and destroyed by these minute forms of life. The first virus disease to be discovered (in 1892) was the so-called "mosaic" disease of tobacco plants, while the first disease of animals proved to be due to a virus was foot-and-mouth disease (1898). During the past twenty years or so a continually growing number of diseases have been proved to be due to viruses and it is interesting to contemplate the reasons for this. In the first place there has of course been, during the period mentioned, much more intensive investigation, with the result that a number of diseases, the causes of which were entirely unknown or which were regarded as due to ordinary bacteria, are now recognised to be due to viruses. This, however, can scarcely be the sole reason for the new position which has arisen, and it does appear to be a fact that new virus diseases have made their appearance from time to time. This may be explained in the following manner. Viruses, being living agents, are subject to the laws that govern other forms of life; among other things they are capable of adapting themselves to new conditions of life, based perhaps on changed nutritional requirements. Now one of the characteristic features of viruses is that they grow actually inside the cells of which the animal body is composed. In this respect they are different from bacteria, which commonly grow in the fluids that bathe these cells. Moreover, particular viruses often grow only within particular cells, *e.g.* the foot-and-mouth disease virus is so specialised in its habits that it will only grow in cells of the skin, the virus of rabies will only grow in nerve cells, and so on. This is the reason why the symptoms of foot-and-mouth disease and rabies are so different that we are easily able to recognise them as two different diseases. Now if we suppose that a given virus, long accustomed to flourish within a particular kind of cell, gradually changes its characters or nutritional requirements so that it gains the ability to thrive in another kind of cell, or perhaps even in another species of animal, we shall obviously be face to face with what is, to all intents and purposes, a new disease. There are a number of instances where one can only conclude that this sort of

thing has happened. Thus, there are strong reasons for believing that swine influenza—a disease to which reference was made in "Agricultural Research in 1932"—came into being about 1918 as a result of the natural transfer to swine of the virus which is now known to be the cause of human influenza. Similarly, there are reasons for believing that the disease known as sheep-pox originated from cow-pox. In this case the virus of cow-pox has not only come to grow naturally in another species of animal, but it has also adapted itself to growth in a different kind of tissue. Cow-pox is an extremely mild affection in which the lesions or sores are confined to the skin of the udder and teats, whereas sheep-pox is often a very severe and fatal disease in which the bronchial passages are extensively involved.

In the following pages a very short account is given of some of the virus diseases of animals and birds which have come to light within comparatively recent times.

Virus Diseases of Horses.

Encephalo-myelitis.

This disease owes its name to the fact that the virus grows in the nervous system, so that the symptoms arise from damage to the brain and spinal cord. It has been reported chiefly from the United States, but it is also known to occur in other parts of North and South America, as well as on the continent of Europe, though not in England. A good account of the symptoms and general nature of the disease has been given by Dr. J. R. Mohler, the Chief of the Bureau of Animal Industry (Ref. 20.). Prior to 1930, when its true cause was determined, the disease had certainly existed for many years in the United States, where it had been given such names as "blind staggers," "brain fever," etc. It must not be assumed, however, that all the cases so described, either in America or elsewhere, are caused by the virus of encephalo-myelitis. The following are the symptoms shown by affected animals. There is at first mild indisposition with some fever, quickly followed by difficulty in mastication and swallowing. The animal then shows paralysis of various muscles, becomes very drowsy and stands with its head hanging low. In other instances there is a tendency to walk continuously with a staggering or stumbling gait. In cases which are likely to die there is inability to stand. Generally speaking, the course is very rapid, the duration being a few days or even only a few hours, but the rate of mortality in different outbreaks is very variable, from 2 to 70 per cent.

Encephalo-myelitis has a rather strictly seasonal incidence, outbreaks occurring during the summer and early autumn and rapidly disappearing with the approach of cold weather; this,

together with the fact that it is confined to low swampy areas, points to natural spread by some insect. It has been proved, indeed, that at least 5 species of mosquito are capable of transmitting the virus and there is some evidence that the virus can actually multiply in the mosquito. With regard to prevention and treatment, a serum has been produced which is of some value for treating early cases, and attempts have also been made, in the United States, to produce a preventive vaccine. M. S. Shahan and L. T. Giltner (Ref. 21) of the Bureau of Animal Industry have demonstrated the value of a vaccine, composed of brain tissue from infected horses which has been treated with a certain concentration of formalin.

Infectious bronchitis, or Epidemic coughing.

The names indicate the nature of this complaint. In 1934 it was shown by certain German investigators to be due to a virus, though there are indications that the disease itself was known many years before this. The disease is mainly one of horses, though it is also said to occur in cattle and swine. In the horse the prominent symptom is a dry, painful, rasping cough, which occurs in paroxysms. The disease is intensely infectious and many horses in a stable may be affected about the same time. The symptoms soon pass off and convalescence is rapid, though pneumonia occasionally supervenes.

What was undoubtedly the same disease as that observed in Germany occurred during the summer of 1935 in the Aldershot Command; an account of this has been given by W. H. Walker (Ref. 22). The trouble spread with great rapidity among army and civilian horses, and all attempts to check it by isolating sick animals were fruitless. Apart from the persistent and painful cough, most of the horses showed a thin watery discharge from the nostril. The duration of the attack in individual animals was, on the average, twelve days and in the affected army unit from three to four weeks. Although the epidemic seriously interfered with military training, all the animals recovered when they were given rest and plenty of fresh air.

Virus Diseases of Swine.

Vesicular exanthema.

Between 1932 and 1935 a series of outbreaks of what was assumed to be foot-and-mouth disease occurred among swine in California. The designation "vesicular exanthema" implies an eruption on the skin of vesicles or blebs, such as are seen in foot-and-mouth disease. It was found, however, that, while the causal virus could be transmitted with ease to swine, it was unable to infect cattle or guinea-pigs. Further, it was

proved that some horses are susceptible, whereas infection of horses with foot-and-mouth virus cannot be achieved. These experiments very strongly suggested that exanthema virus is different from that of foot-and-mouth disease, a conclusion supported and extended by work carried out in Germany and also in England (Ref. 1). Everything then points to "vesicular exanthema" being a new disease of swine, though, so far as can be ascertained, it has not yet been met with outside California.

Swineherds' disease.

In 1926 there appeared among pig attendants working in Switzerland, and in the mountainous region between that country and France and Italy, a disease mild in character, with symptoms which aroused a suspicion of influenza, typhoid fever or meningitis. The disease, however, was quite obviously connected with the occupation of looking after swine, since companions of the sick people, who were engaged in other occupations, were unaffected. On enquiry it was found that the pigs themselves had recently suffered from some comparatively slight ailment, the symptoms of which suggested some nervous disorder. Subsequent experimentation has left little room for doubt that a virus was the cause of the trouble. The disease has been transmitted to the pig from a natural case in man and *vice versa*, using blood for inoculation. Rats are known to be susceptible and are possibly concerned with the spread of the virus in nature.

Swine-pox.

All species of domesticated animals, as well as man, have their "pock" diseases, the characteristic feature of which is an eruption on some part of the skin or of the mucous membranes. In man, the disease is known as variola or small-pox; in the cow as vaccinia or cow-pox. Although these diseases, as they occur naturally, appear to be quite distinct and do not spread from one animal species to another, there is reason to believe, as indicated in the introduction to this section, that the viruses of the different pock diseases are related to one another; in fact, they are quite likely to have descended from a common stock, namely, the virus of cow-pox.

Swine-pox is a well-known disease in certain parts of Europe, especially in Hungary and the Balkan States. The disease varies greatly in its clinical manifestations; sometimes it is severe, highly fatal and affects pigs of any age; at other times it is quite mild and is seen only in young pigs. For this reason, it has been suggested that there are two somewhat different pock diseases of pigs, a severe form representing what may be called true swine-pox and a mild form due to the cow-pox virus.

Apparently in England it is the mild form that occurs and, it is said, fairly extensively. An outbreak, noted in 1936, was described by F. Blakemore and R. E. Glover (Ref. 23) of Cambridge. The illness first appeared on the particular farm during August and most of the pigs born subsequently got it, most frequently between the ages of three and six weeks. The source of the infection could not be determined, as there had been no trouble previously and no pigs had been bought. The affected pigs were dull and disinclined for food; shortly afterwards reddened areas up to half-an-inch in diameter made their appearance on various parts of the skin. These progressed to form scabs which could easily be detached, leaving little trace. The disease ran its course in about three weeks and, although most of the pigs showed only a slight set-back in condition, a few remained unthrifty and were not worth rearing. The outbreak showed no tendency to die out until the sick animals were segregated and sows, as they farrowed, were isolated with their litters until the piglets were six weeks old. Blakemore and Glover proved the inoculability of the disease by applying some scab material to the skin of a young healthy pig. It seems, however, that more information is required about the nature of the disease, and particularly about the relationship of this mild form of swine-pox to the pock viruses of other animals.

Virus Diseases of Poultry.

Laryngo-tracheitis or Contagious Bronchitis.

This disease, which is mainly one of fowls, was first described in the United States in 1920. Since then it has been reported in several other countries and in 1935 was found in England by N. Dobson (Ref. 24) of the Ministry of Agriculture. As the name implies, the disease affects the larynx and wind-pipe or, in fact, any part of the respiratory passages. The symptoms include coughing and sneezing, breathing through the half-opened beak with the neck extended during inspiration, and rattling or gurgling sounds in the throat. The birds show a watery discharge from the eyes and nostrils and from time to time cough up blood or blood-stained mucus. Laryngo-tracheitis is to be distinguished from that form of fowl-pox known as fowl diphtheria, in which cheesy deposits form in the mouth and throat. The disease can be set up in healthy birds by introducing a little of the mucous discharge into the wind-pipe or by placing them in contact with affected birds; the symptoms described may then be expected to appear some three days later. The disease can also be communicated to healthy birds by placing them in coops which have been occupied by sick fowls. Birds may be visibly ill for only two or three

days, but the mortality varies considerably, sometimes reaching 80 per cent. and at other times being as low as 10 per cent. It has been proved that some recovered birds can harbour the virus for a period of a month, or occasionally for as long as a year.

According to a statement from the Ministry of Agriculture (Ref. 25) a number of independent and widely scattered outbreaks of this disease have been discovered in England since the beginning of 1935. The outbreak reported by Dobson in 1935 occurred in a large fattening plant and it was estimated that during a period of about eight weeks over six thousand birds were affected out of a total of eighteen or twenty thousand.

With regard to prevention, application of virus to the cloaca or vent has been suggested as a means of immunisation. The local inflammatory process set up in this way is not dangerous, and is said to make the bird resistant. Such a practice, however, should be adopted only in areas where the disease has existed for a long time and where nearly all the flocks are affected. In other cases, a complete slaughter policy is recommended. As the virus is somewhat resistant to desiccation, very thorough cleaning and disinfection of poultry houses must be carried out.

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FARM IMPLEMENTS AND MACHINERY.

Power Farming.

As time goes on the differences between power farming and any other kind of farming become less and less clearly defined, so that it must soon become doubtful whether power farming as such is any longer entitled to separate discussion here. This does not mean that all our farming is becoming mechanized—we have still a very long way to go before that state is reached—but the forty-odd thousand tractors referred to later as being in use in this country must, in fact, mean that on a very big proportion of our arable acreage the main source of power is mechanical, and the very wide distribution of these tractors and their implements must mean that, whether they have direct experience or not, few farmers can be ignorant of their uses and possibilities. With these facts in mind it is interesting to be able to refer to two papers which, between them, give a very clear picture of the present position of power farming, of the way in which it has developed from the large farm to the small, and of the way in which it is being superimposed on existing systems of management. Thus the first paper describes relatively large-scale mechanized corn growing: the "specialized" type of farming in which mechanization in this country originated, and about which so much discussion and criticism was raised a few years ago. The second deals, on the other hand, with the mechanization of the small and medium farms, which cover a very much wider range of activity than the specialists but nevertheless owe to them most of their original inspiration in regard to machinery.

Bridges and Weeks (Ref. 1) give a detailed account of the working over the last three years of eleven farms, varying in size from 489 to 1,113 acres and all devoted primarily to cereal growing. These farms are just about as completely mechanized as they can be since between them they have only 13 horses—about one horse to 600 acres. All of them, therefore, rely almost exclusively on tractors for cultivation, the most common

ploughing unit being a tractor of between 15 and 25 drawbar h.p. and a 4-furrow plough. Only a few out of the many details of equipment can be mentioned here. Over the whole series of farms the tractors in 1936 worked an average of just over 200 acres of arable land apiece, or 10·6 acres for every horse-power (standard drawbar rating). Ploughing equipment was available at the rate of about one mouldboard per 60 acres. The tendency over the three years considered has, however, been to increase the available tractor power by about 20 per cent., a much greater increase than can be accounted for by the progressive reduction in the number of horses. One of the main difficulties in applying similar methods on more mixed holdings is the question of internal transport. On the farms described transport is done by motor lorry or by tractor trailer, and the overall equipment includes only one lorry or trailer to 262 acres. How the owners would adjust matters if livestock were to be introduced in appreciable numbers is an interesting speculation to which no answer can be given at the moment.

It is pointed out that these farms are exceptional as regards size and that the kind of farming they practise is comparatively unimportant to the agriculture of the country. On the other hand, they, and other similar farms, represent the profitable use of a considerable acreage of land which in all probability would otherwise be derelict. Having regard to the state in which most of them were taken over their yields are reasonably good, just about equalling the average yields for the whole country. Moreover, there is no indication that yields are declining through lack of humus. No detailed accounts are available, but it is estimated that a farm of this kind can pay management and interest charges even if the yield of barley or wheat does not exceed 3½ quarters. Since the 3 years' average for the farms as a whole is over 4 quarters it is to be presumed that they are reasonably profitable enterprises. The authors suggest that it cannot be argued that this type of farming is displacing labour since no other system could afford to employ labour at all on the land in question. On the other hand, mechanized farming offers a capable worker good wages and shorter working hours. It therefore attracts the most progressive class of worker—the class, in fact, who might otherwise be tempted to forsake agriculture for urban industry.

Discussing mechanization on smaller farms Cashmore (Ref. 2) points out that, by reason of their more varied cropping, these present more difficult problems than had to be overcome on the larger farms. The mechanization process is a gradual one: first a small tractor is introduced without appreciable reduction in the number of horses, and is used almost exclusively for ploughing and pulling a binder. Then the activities of the

tractor are increased (sometimes by making it pull horse implements) until it has, in effect, replaced one man and two pairs of horses. The next stage is the replacement of many of these horse implements by specially designed tractor implements with a considerable gain in efficiency; finally comes the realization that it is better sometimes to use the tractor for light, and therefore unprofitable, operation than to have horses and tractors overlapping. From the many different items of equipment which Cashmore describes it is clear that there is no standardization of method on these smaller farms: in fact, their successful mechanization depends very often on home-made contrivances designed to meet the conditions ruling on individual farms. An example of what might be called the balanced use of mechanization on a large holding is provided in a paper by Troup (Ref. 3) which gives a general description of the organization of the Leckford Estate of nearly 4,000 acres in Hampshire. This is a very diversified enterprise which is apparently controlled by two very sound principles: first every department must pay its way independently; and secondly the general organization must be such that the labour displaced from one branch is absorbed as far as possible by another. In these circumstances one might expect to find a partial form of mechanization depending mainly on small tractors. Actually, however, power for the heavy work is provided by six fairly large tractors, all of the track-laying type, and there is only one small wheeled machine. All the lighter work and the transport are done more economically by horses which, on such a large and varied holding, can be employed uniformly all the year round. We have thus the apparent paradox of an estate which is large enough to use—and does in fact use—large tractors and wide implements but which can also use horses efficiently—again simply because it is large enough. This bears out one aspect of Cashmore's paper: that there are still plenty of jobs for which horses are at least as economical as tractors were it not for the difficulty, on a small farm of choosing between the alternatives of feeding idle horses for a considerable part of the year or using them for work for which they are definitely uneconomical.

A further example of the way in which mechanization is creeping into general agriculture is provided by the papers read at the Third Oxford Farming Conference held early in the present year (Ref. 4). Although on this occasion the Conference programme was drawn up without special reference to the use of mechanical power or of special equipment, the papers show that progressive farming in every branch is very definitely linked up with such developments. One might almost say that if, in the papers and discussions as a whole,

the word "tractor" occurs less often than the word "horse," it is because the former is taken for granted while the latter has often to be justified.

Tractors.

An official enquiry addressed in September last to all occupiers of agricultural holdings over 1 acre in extent in England and Wales disclosed an estimated total of 46,417 agricultural tractors, including 1,500 track-laying machines and 2,420 machines used for stationary purposes only (Ref. 5). These figures have also been analysed by counties (Ref. 6). The analysis shows that while, as might have been expected, tractors are most common in the large-scale arable districts, relatively large numbers are also to be found in some counties, such as Devon, which are by no means predominantly arable in their farming. Another point of interest arises from the fact that tractors are extensively used in both Essex and Kent. Since one of these counties is generally associated with heavy land and the other with intensive methods of cultivation, the official figures suggest that mechanization—in the sense of the replacement of animal by mechanical power—can no longer be regarded as being the special prerogative of extensive light-land farming.

During the past year a very promising start has been made with a new Tractor Testing Scheme organized, in consultation with other authorities, by the R.A.S.E. Individual test reports on 16 machines have already been published (Ref. 7) while it is likely that, by the time these notes are in print, a further 10 machines will have been tested. A summary of the test results on the first ten entries has also been published elsewhere, together with full particulars of the Scheme itself (Ref. 8). The main features of the latter are that the tests shall be carried out on strictly practical lines so as to provide information of direct value to farmers, and that they shall involve a minimum of expense to the entrants of machines. In effect, the tractors under test are put to do an ordinary job of ploughing under ordinary farm conditions, accurate measurements of such quantities as drawbar pull, speed, fuel consumption and width and depth of work being made meanwhile. Ploughing tests are carried out on both "light" and "heavy" land, and in each case two sets of results are given: first the results actually achieved by each tractor on its own plot (the soil on which may have differed somewhat from that on the plots ploughed by other machines); and secondly a comparative estimate, based on the measurements made during the tests, of what each tractor would have accomplished on "standard" land with characteristics representing the averages, for light and heavy land respectively, of all the plots concerned. The one set of results

therefore provides a direct measure of the capabilities of each individual machine, while the other provides a means of making fair comparisons between different machines which may even have been tested on different occasions. In two notes by the present writer (Ref. 9) it is pointed out that the results of the first tests under this Scheme provide ample confirmation of an opinion which he and his colleagues have expressed on more than one occasion, namely that tractor users waste considerable sums of money annually through not loading their tractors efficiently. The first of these notes includes an estimate of the ploughing rates which tractors of various sizes ought, on the basis of the R.A.S.E. test results, to accomplish when working on different types of land. In the second, these estimates are compared with some typical results achieved in actual practice; and an attempt is made to account for the enormous discrepancies that the comparisons disclose. The conclusion reached is that nothing but gross underloading can, in fact, account for them. For the present purpose the sort of discrepancy to be explained can be put as follows: the "standards" for light and heavy land as used in the tests were such that the draught of an ordinary general-purpose tractor plough, turning 9·5 inch furrows, would average rather over 360 lb. per furrow on the former and rather under 750 lb. per furrow on the latter. Since the working draught of a really good horse is commonly estimated at 250 lb. the two types of land concerned might be described as "strong three-horse" and "light two-horse" respectively. On the basis of performances achieved under test the ordinary small wheeled tractor of about 12/20 nominal rating ought to be capable of ploughing a full acre per hour on the lighter land and something over half an acre per hour on the heavier. A typical result with the same class of tractor in actual farming practice is an average of rather over a quarter-acre per hour on land intermediate in character between the two standard types referred to above. In other words the actual performance on the farm is often only about one-third of the performance recorded in an 8-hours test in which everything possible was done to adhere to ordinary farm conditions, and in which, so far as one could judge, no special attempt was made to force the pace. Since the influence of inadequate loading on overall working costs is not dealt with specifically in the papers under review, it may be well to recall that the subject has been discussed in some detail in two earlier papers (Refs. 10 and 11). Put in its simplest form the argument is that it costs nearly as much per hour to run a tractor idly round a field as to run it with a full load, so that if, by proper loading, the tractor's output can be appreciably increased, a very real economy in working costs per acre will be effected. Incidentally, the R.A.S.E. test results

suggest that in many cases the output might be increased by as much as 50 per cent., with a potential saving far in excess of anything one might hope to accomplish by using one brand of fuel or oil rather than another, or even by taking pains to improve the fuel economy of the power unit. In these circumstances it may, at first sight, be surprising to note that American writers on tractor economy devote much more attention to fuel costs than to efficient loading. It must, however, be remembered that while our own research and experimental work is almost entirely confined to problems of tractor utilization, American workers, both within the agricultural engineering industry and outside it, are actively concerned with problems of tractor design, in which fuel economy plays a very important part. Moreover, being an oil-producing country, America has a very much wider range of possible fuels to contend with so that, even when tractor utilization is the main concern, fuel problems are relatively more important than they are over here. In this connection three contributions to a recent discussion on tractor fuel economy are of interest because they represent three distinct points of view: those of a tractor designer, an oil refiner, and a Professor of agricultural engineering respectively (Ref. 12). All three writers reach the same general conclusion: that a greater degree of standardization of tractor fuels is an urgent necessity; and they are more or less in agreement, too, as to what the specification of the standardized fuel should be. In order, however, to understand these conclusions, and to appreciate what they mean in terms of tractor fuels as we know them in this country, it is necessary to know something of the way in which the oil industry has developed during the last thirty years or so. In the early days all crude oil was refined by straightforward distillation—that is by boiling off certain fractions at definite temperatures—and Kerosene (or paraffin in the lamp-oil sense) was easily the most valuable of the resulting products. At that time petrol was no more than an embarrassing by-product which had to be disposed of by any means available—often in fact by simply letting it run away to waste. This situation, however, was completely changed by the introduction and development of the Otto-cycle engine, which quickly brought petrol into the position of the most valuable product. More recently the original balance has been still further upset by developments, such as the diesel engine, which have created a demand for the heavier and less volatile petroleum products; by the ever-growing importance of high-grade lubricating oils; and by the gradually diminishing importance of paraffin as a means of illumination.

The agricultural tractor, although first introduced at a much earlier date, did not begin to come into general use until

the first major change in the oil industry had taken place and petrol had become appreciably more expensive than paraffin. In consequence paraffin (lamp oil) became the standard cheap agricultural fuel, and in many places has maintained its position as such until quite recently. In the meantime, however, changes have taken place in the refining industry itself due to the introduction of "cracking"—a refining process which gives an appreciably higher proportion of petrol than can be achieved by the straightforward distillation of crude oil. This process is of importance to agriculture not because it gives a higher yield of petrol, but because it results in the production of a range of intermediate products which correspond to paraffin in the sense that they are heavier than petrol and lighter than the so-called fuel oils, but which possess special qualities of their own, making them particularly suitable as fuels for low-compression engines of the type normally fitted to agricultural tractors. Out of these intermediate products of the "cracking" process—very often blended with suitable products of straight distillation—have come what may be called "designed" tractor fuels—that is fuels designed expressly for use in engines of the normal tractor type, as opposed to fuels which are used in tractors simply because they happen to be cheap.

The present position is, then, that the American farmer who uses a spark-ignition tractor has four main types of fuel to choose from :

1. Petrol—which, when used for agricultural purposes is tax-free in several States.
2. Lamp oil—which is no longer a specially cheap fuel, but which, due partly to long-established custom and partly to the convenience in isolated districts of using a common fuel for both power and domestic purposes, is still fairly widely used in tractor engines.
3. Tractor Distillates—designed expressly to give optimum performance in tractor engines, and probably resembling in general character our standard grades of Vaporizing Oils.
4. Other cheap distillates—not standardized in any way and consisting mainly of surplus residues which have to be sold for what they will fetch, and for which the farmer provides a convenient and not very critical market.

These are the fuels with which American writers in general, and the three papers now under consideration in particular, are concerned. As regards the first three types of fuel the discussion proceeds on familar lines : petrol, even in America,

is relatively too expensive for general use; lamp oil is open to objection on the grounds both of its low volatility and also its low anti-knock rating; designed tractor distillates (or vaporizing oils) have outstanding advantages although, in America at any rate, they need to be more closely standardized and to be coloured or named so that the prospective purchaser cannot possibly confuse them with other fuels which may be offered for sale. All the doubts and difficulties arise from the fourth class of fuels—the cheap unstandardized distillates, which—because of the general principle that everything that comes out of an oil well must if possible be sold to someone—exist, and are offered to farmers, in an almost infinite variety. It is pointed out that, whatever oil refiners and tractor designers have to say on the subject, farmers will continue to buy cheap fuels unless there is something obviously wrong with them; and often only a very critical examination could show up their defects. The subject is too complicated for further discussion here although one example, which seems to be fairly typical in America, can be given. A " heavy " residue, probably containing a dangerously high proportion of gums and tars, may be " laced " with petrol and sold as a high-volatility tractor fuel. To expose the presence of the undesirable elements would require a complete distillation test quite outside any farmer's experience. On the other hand, because of the " lacing " with petrol, the apparent performance of the fuel in a tractor may be very good—the engine may start more readily than with a genuine tractor distillate, while if a rich enough mixture is used it may well operate satisfactorily at a lower temperature. Nevertheless such a fuel cannot be really economical for, in all probability, all the heaviest portions will pass unburned into the sump; and, both from dilution and gumminess, trouble is likely to result. Unfortunately, however, when troubles in the shape of engine repairs or depreciation do eventually set in, it will not be at all easy to trace them definitely to the fuel.

Just how far the same sort of dangers may exist in this country is uncertain. On the one hand our branded vaporizing oils are probably much more closely standardized than the corresponding American grades. On the other hand, our farmers, too, frequently have cheap alternative fuels offered to them. Are these cheap fuels, like many of the American cheap fuels, potentially dangerous to tractor engines; or are they fuels which, but for being surplus to the immediate requirements of the main distributing companies, would probably have been incorporated into the standard brands of vaporizing oil? This is a question which can only be answered by independent research inspired by a rather greater interest in the technical side of fuels than at present exists here. In the meantime, anyone who is interested in the general question of

tractor fuels should consult two further papers (Refs. 13 and 14). In the first, Frudden gives a very clear exposition of how engine power and fuel consumption depend on such factors as compression ratio and manifold temperature, and of how the latter are influenced by the volatility ranges and anti-knock characteristics of the fuel. The main points are that the higher the compression ratio and the lower the inlet manifold temperature, the greater the power output and the better the fuel economy. But in order to use a high compression ratio without excessive detonation the fuel must possess suitable anti-knock characteristics, i.e. a relatively high Octane number; while to operate satisfactorily at a reasonably low manifold temperature the fuel must be volatile, i.e. it must have a satisfactory distillation range. In the second paper, Bayer and Gale give the results of analyses and engine tests of a large variety of different distillates and thus give a practical illustration of some of the theoretical points concerned.

In France great efforts are being made to encourage the use of home-produced fuel in the form of charcoal, not only for agricultural tractors, but for road vehicles of all kinds. An official publication on the subject (Ref. 15) gives very complete particulars of a number of different gas producers, together with much technical information about the use of producer gas in internal-combustion engines originally designed for petrol. The same publication gives the results of a number of formal tests of equipment. Since charcoal is not readily available in this country any corresponding interest in gas producers would have to be based on the use of anthracite or some similar coal product. However, as regards both their original heat content and the general properties of the gas produced from them, charcoal and anthracite are very similar: and most of the information given in the publication has therefore a direct bearing on the possibilities of the latter fuel. In a note based on the information given therein (Ref. 16) it is suggested that, without taking into account the costs of conversion, fuel costs would be lowered by a change-over from tractor paraffin to producer gas so long as anthracite could be bought for less than £5 5s. per ton. At present prices, therefore, there would be a very real saving; and, since the cost of some of the French conversions is no more than £50 at the present rate of exchange, the subject would appear to merit further attention. It cannot, however, be assumed without trial that producer equipment designed to burn charcoal will burn anthracite equally well.

Although a great deal of material relating to tractor wheels and tracks has been published in recent years, it is doubtful whether actual tractor users have been able to get very much practical information from it. One difficulty is that, while real research papers on the subject are generally too technical in character to be easily understood by farmers, much of the less

technical literature comes from more or less interested sources, and, only too often, presents only one side of the case for or against the particular type of equipment concerned. In this connection a series of articles summarizing present knowledge about wheel and track performance, and explaining some of the technical points involved, may be of interest (Ref. 17). In regard to steel wheels it is pointed out that the lug type of wheel (in which the adhesion devices are relatively long and narrow) appears to have definite theoretical and practical advantages over the straked type. Apart from this general difference, however, and the superiority from many points of view of the rimless wheel, it cannot on general grounds be expected that any one particular pattern of wheel will be markedly superior to another. With pneumatic-tyred wheels on the other hand technical performance is only of secondary importance since, in this country at any rate, their use depends almost entirely on their general convenience. American writers on pneumatic tyres are devoting much attention at present to tyre sizes. Shields (Ref. 18) points out that it is illogical to rate tractor tyres in the same way as industrial tyres—by choosing the tyre simply to fit the weight carried by it—since practically all tractor tyre failures are of the " diagonal sidewall buckle " type, and arise from the magnitude of the horizontal pull transmitted. The alternative method which he suggests for choosing tyres appears, however, to come to much the same thing in the end. Wileman (Ref. 19) discusses the effect of tyre size on tractor efficiency in the light of some tests in which two sizes of pneumatic-tyred wheels were compared with steel wheels on two tractors used for various cultivating operations. As regards the relative efficiencies of the two sizes of tyres the tests do not appear to have given any very definite results although, due to their lower rolling resistance, both types of pneumatic equipment gave consistently lower fuel consumptions than the steel wheels. So long as tests are carried out at relatively high speeds the latter result is of course inevitable. It may be remarked here that only too often one hears it claimed in regard to comparative tests of steel wheels and pneumatics that " with the pneumatics it was possible to pull the same load in a higher gear, and thus to achieve both a higher rate of working and a saving of fuel." Such a comparison is, however, meaningless unless it is known (1) that the load concerned was a full load for the steel-wheeled tractor in the lower gear, and (2) that the steel wheels could not have achieved still more by working with an even bigger load in the lowest gear available. With this criticism in mind it appears that a rather fairer picture of the relative merits of the two types of equipment is given by some tests reported by Murdoch (Ref. 20). These set out to determine how the overall costs of certain tractor operations, such as ploughing and

cultivating, were affected by the particular wheel equipment used; and each individual test was repeated, whenever possible, in all three gears of the tractor concerned. Each type of equipment was thus given, in effect, a chance to show its merits under the conditions best suited to it with the result that no spectacular cost differences were disclosed, while in several instances the steel equipment had the ultimate advantage.

Another publication by the same author (Ref. 21) contains so many figures and formulae that it is doubtful whether anyone will find time to read it.

In the last of the series of papers on pneumatic tyres Harper (Ref. 22) makes comparisons with steel tracks on both tractors and trailers. This is not a very useful comparison from the farmer's point of view but the author makes one useful point clear: that the term "coefficient of traction" (with which pneumatic tyre enthusiasts make much play nowadays) is quite meaningless unless accompanied by some sort of specification of wheel slip. He gives some very interesting diagrams showing how wheel slip varies with different conditions.

Tractor costs on a mechanized farm are discussed by Lee and Upfold (Ref. 23), in a paper which is based on exceptionally detailed records from a 500 acre farm using two medium-sized tracklaying and one small wheel tractor. The policy of the farm concerned led to the replacement of all these tractors within the 5-year period covered by the records so that the costings leave no "loose ends" hanging out: depreciation figures for example are exact. The average overall cost was 4*s.* per hour for each tracklayer and 2*s.* 9*d.* per hour for the small wheeled machine. The three machines between them averaged 3,342 tractor-hours per year.

Finally, a paper by Bayer (Ref. 24) deals with a rather curious question of tractor utilization: is it better, from the point of view only of efficiency of tractor operation, to work a hillside field up and down the slope or along the contours? The answers provided by a quite extensive series of tests was that working up and down the slope required 13 per cent. less power but occupied 13 per cent. more time; so that just about the same amount of energy in horse-power-hours was required in both cases. On the other hand, contour working showed a fuel saving of nearly 10 per cent. The reason suggested for the latter result was that, in the contour working, the tractor was uniformly loaded at about its optimum efficiency, while in working up and down it was in each bout provided first with rather too much load and then with rather too little. Since, in the ordinary way, one would hardly expect to find the load so nicely adjusted it is clear that the experimental result might very well be reversed in practice. Moreover, in this country the method of working a hillside field would almost

certainly be decided by some factor (such as drainage) quite unconnected with tractor efficiency.

Cultivating Implements.

From the fact that well over half a century of mechanical cultivation has resulted in no appreciable change of method we may deduce—according to our individual point of view—either that the farmer is over-conservative in his attitude to new developments, or that traditional methods are so essentially sound as to be virtually incapable of improvement. Or, if we choose to be guided by the results of modern experiments, we may possibly conclude that the whole business of cultivation is grossly overdone anyway. And when this latter point of view is seriously put forward—as has recently been done by Keen and Russell (Ref. 25)—it is sometimes not easy to combat. For one thing, arguments of the " 500,000 farmers can't be wrong " type—on which all practical farming is, in fact, based—are inadmissible by the rules of the game. Moreover, one feels very often that the experiments, and the immediate deductions made from them, are perfectly sound—if only they had anything at all to do with the general question at issue. In the present instance, however, it is unnecessary to go to much trouble to oppose the " challenge " put forward by the authors concerned—" we believe that the present accepted standards of good cultivation are wastefully high "—because they have, in effect, done the job themselves in another paper (Ref. 26). In this, precisely the same experiments are presented in more scientific form, with a much more reasoned discussion, and the " challenge " becomes the relatively mild conclusion that the farmer appears to possess a wide freedom " in choosing what implements to use or what operations to carry out." As for the experiments themselves, some are clearly of much greater interest than others. For example, it will not cause much heartburning to hear that subsoiling has no marked effect on land which is known to have no obvious pan or plough-sole. Again only a very optimistic farmer would expect a second ploughing to give an appreciably higher yield on land capable (without the extra ploughing) of growing 11·4 tons of potatoes or 15·4 tons of sugar beet to the acre. One cannot, however, help remarking that, if it is really true that yield increases of 5 cwt. of potatoes or 7 cwt. of sugar beet were insufficient to pay for the cost of an extra ploughing, then it is not the cultivation standards but the Rothamsted working costs that are wastefully high. Much more interesting are the experiments on seed-bed consolidation and those on the inter-row hoeing of root crops. As regards seed-bed consolidation it is pointed out that the tracks of tractor wheels are sometimes shown up in cereal crops by strips of better growth; that measurements made at Wye College in 1931 showed in one

instance that this effect resulted in a yield increase of nearly 100 per cent.; but that experiments in which consolidation by tractor wheels was deliberately introduced gave no significant result (Ref. 27). In a more recent note from Wye increased yields in tractor-wheel tracks of 40 per cent. in 1936 and 20 per cent. in 1937 are reported (Ref. 28). The same effect was noticed at Rothamsted in a part of a sugar beet field that had been heavily consolidated by the passage of farm carts in Winter; and formal experiments were laid down in two successive years to see whether the same effect could be produced by heavily rolling the seed-bed. Once more no significant increases in yield resulted from the treatment.

What for brevity can be termed the "tractor-wheel effect" is discussed at some length in connection with these experiments: it occurs erratically, nearly always on poorish soils, and appears to be equivalent to a top dressing of nitrogen on nitrogen-starved land; but whether it is due to compaction of the surface soil before ploughing, or of the subsoil, is unknown. It so happens that the very dry spring of the present year gave rise to an extraordinary number of instances: some of them (in oat crops) still plainly visible at the time of writing, although there is only a fortnight to go to harvest time. And one may perhaps take Keen and Russell's interest in the subject as an excuse to mention one particularly interesting case which may otherwise escape notice. The crop was barley following barley in a rotation in which two corn crops are followed by a one-year ley on fairly high-yielding land overlying chalk on the extreme edge of the main chalk belt. The top soil contains a considerable amount of clay and is rather heavy to work: none of this year's crops showed any marked signs of suffering from drought. The tractor in question was fitted with open-type wheels of a very unusual pattern, and the exact pattern of the wheel strakes was reproduced in the young barley in the form of areas showing both better growth and a definitely thicker plant. The tractor is one of three which are used on the farm concerned and was used in the cultivation of this particular field on one occasion only, for the first spring cultivation (with a Pitch Pole Cultivator in February) after Winter ploughing. In this particular instance, therefore, due to the happy accident of a peculiar type of wheel being used for one operation only, there is no doubt as to when the effective consolidation took place; and since the cultivation was done at a slight angle to the final drilling, there was no possibility of confusing the resulting "tractor-wheel effect" with any other effects that might have arisen. If consolidation was indeed the cause, then one can draw one or two conclusions which may have a bearing on consolidation experiments in general. First the consolidation was not a surface effect (if only because the surface

was quite deeply stirred about in several subsequent operations). Secondly the effect was nothing like a uniform consolidation; for if it had been, the exact wheel pattern would not have been reproduced. In fact, to judge from studies of tractor-wheel action made in quite another connection, one would conclude that the effect must have been to produce something like artificial clods somewhere beneath the surface. Finally, and most important, the intensity of consolidation must have been right outside anything that is ordinarily produced even by intensive rolling. The tractor drive wheels carried a weight of something like 30 cwt.; their combined width was only two feet; while, due to their peculiar pattern, the whole weight must have been carried by an area of soil certainly no greater than one-tenth of the area which would have supported a plain roll of equal width. In order to produce an equivalent vertical pressure an 8-foot farm roll would have had to carry a weight of something like 60 tons and even then the horizontal pressure and slip (arising from the fact that the wheels were transmitting a considerable drawbar load) would have been lacking.

In the Rothamsted experiments on inter-row hoeing, "intensive" hoeing, repeated up to eight times in all, was compared with the two or three (or in one case five) hoeings necessary just to check weeds and prevent the formation of a cap. Experiments were carried out on sugar beet in three seasons and on two types of soil, and on one occasion only with kale. In each case extra hoeing reduced the yield while in three instances out of five the reduction was significant. No criticism of these experiments can be offered, beyond the doubt whether the results mean, in terms of ordinary farming, quite as much as the authors seem to suggest. It is true that books and articles on the growing of sugar beet state that the hoes should be kept moving in the crop as long as possible; and it may also be true that farmers, in the main, regard the statement as correct. But one wonders whether many crops in practice do, in fact, actually get much more hoeing than is necessary to prevent capping and keep down weeds. Desire so often outruns performance that most farmers are probably well satisfied if they can keep pace with the latter requirement. Moreover, if hoeing has any special "mulching" effect, it will almost certainly be most important in the early stages of growth—just at the time when the hoes are in any case kept as busy as circumstances allow—in the interests of weed control. There is in fact no very good reason to expect extra hoeings done at a rather late stage of growth to show to advantage in an experiment; nor is there any reason to suppose that farmers really waste much money in doing them in practice.

The rest of the second Rothamsted paper must be discussed in a few words with the injunction that everyone who is interested

in cultivation experiments—and particularly everyone who was interested by the "challenge" paper—should read the original: not only the experimental results but the very interesting comment that accompanies them. The one other point worth mentioning here is the general outcome of the experiments on deep and shallow cultivations with ploughs, grubbers and the roto-tiller. Ploughing to a depth of more than 4 inches was rarely worth while, although there was definite evidence that, if ploughing was replaced by the sometimes easier alternatives of grubbing or roto-tilling, deeper working (down to 8 inches) was advantageous. In a single season, the choice between the various alternative methods of starting seed-bed preparation did not make much difference, although there was some evidence that avoiding the plough altogether, over a number of years, would eventually result in dirty land. As an engineer, however, one wonders just how often roto-tilling to a depth of 8 inches on ordinary stubble (not one of the highly cultivated Rothamsted fields) would be an easy, or even a quick, alternative to shallow ploughing *plus* harrowing and so on.

In still another paper (Ref. 29) Russell and Mehta discuss what may be called the inner features of the same series of cultivation experiments: analysing a host of different measurements, from the crumb sizes of the tilths to the distribution of the weed seeds; and from the circumferences of the mangolds on the root plots to the dryness of the flour made from the produce of the wheat plots. Their paper reaches no new conclusion—in fact its object is rather to explain more fully the significance of the few conclusions already recorded. At the same time, it stands as a striking testimony to the enormous amount of work that is put into a modern experiment.

From roto-tillage it is only a short step to the latest Cambridge paper on Gyro-tillage (Ref. 30). So far as experimental results go this adds little to the position reported earlier (Ref. 31): in spite of measurements which show that the physical effects of gyrotillage are discernable more than two years after the work has been carried out, none of the experiments shows any significant result either for or against the process. Some cases in which wet conditions, prevailing at the time of gyrotilling or just afterwards, have had most unfortunate consequences are, however, mentioned.

By way of contrast to all the above work it is interesting to notice that current American studies of tillage implements (apart from those arising directly from soil erosion) are directed, not at seeking alternatives to the plough, but at improving its efficiency. On the soil side Kummer and Nichols (Ref. 32) are carrying on a lengthy investigation into the physical factors which affect adhesion and friction between the soil and the metal

surface of the implement. This work is still a long way from reaching any conclusions which can be put to practical use by either farmers or designers; the results however already suggest that the practical performance of say, a plough breast may be profoundly influenced by the composition and crystal structure of the metal of which it is made. Randolph and Reed on the other hand, working at the Farm Tillage Machinery Laboratory described in last year's *Farmer's Guide*, are studying in detail the mechanics of mouldboard ploughs (Ref. 33). Their field studies show that the draught of a given plough varies widely, not only from one soil to another, but with different conditions in the same soil. The three soil properties which, in their view, mainly affect draught are moisture content, apparent specific gravity, and the clay or colloid content; but even when all these have been taken into account, considerable variations still exist. The "soil-tank" studies are concerned mainly with the effect of the various external factors, such as speed, depth and width of cut, on the principal force reactions of the plough. These reactions consist of a vertical component (the apparent weight of the plough) and two horizontal components (the draught and the side thrust); and each is expressed as a pressure per unit area of furrow-slice cross-section. One of the most interesting results concerns the effect of ploughing depth on what may be called the specific draught (i.e. the draught per unit area of cross-section of furrow-slice). It is commonly assumed that, provided the normal depth of cultivation is not exceeded, the specific draught is constant for a given plough in given soil, or in other words, the actual draught varies directly as the depth of ploughing. It now appears, however, that as the depth of ploughing is progressively increased the specific draught first decreases to a minimum value and then increases again. This means in effect that any particular plough has a "most efficient depth of working" at which its draught is less in proportion to the volume of soil moved than at any other depth. Another point of interest is that the relation between specific draught and speed is apparently not linear but parabolic, so that, for example, the draught increases by a much greater amount for a change of speed from say 4 m.p.h. to 5 m.p.h. than it does when the speed changes from 3 m.p.h. to 4 m.p.h. This result has a direct bearing on working speeds in practice: in fact, it adds another strong argument to the general case against high-speed working. Finally it may be mentioned that Randolph and Reed's measurements indicate that land-side friction makes up an appreciable part of the total draught. In this fact the solution of the "low-draught plough" mystery is probably to be found since clever adjustment of the rear plough wheel can, by relieving land-side pressure, reduce overall draught quite appreciably. Whether such an adjustment can

always be made without impairing the efficiency of the ploughing is another matter.

Finally, reference may be made to a very interesting summary by Nicholson of the present position of field drainage (Ref. 34). His account of the Spring of 1937 reads strangely in 1938; but drainage is essentially a long-term problem, and few people will quarrel with his appeal for more consideration of our present drainage requirements. In particular he maintains that since, with modern equipment, mole drainage costs no more than some of the heavier cultivations (about whose efficiency there is much argument) we ought to regard mole and surface drainage as routine operations to be carried out at regular, and fairly frequent, intervals.

Grass Conservation.

During the past year information on grass drying has been brought up to date by a paper in which Roberts briefly reviews progress up to the middle of the 1937 season (Ref. 35); by a detailed study of production costs on nine farms during the same season by Dixey and Darke (Ref. 36); and by a Conference discussion in which several owners of grass-drying plants took part (Ref. 4). After noting that the number of driers in operation at the start of the 1937 season showed an increase of only about 50 per cent. over the previous year—a much smaller increase than some people had anticipated—Roberts' paper is concerned mainly with discussing whether dried grass, as produced in practice, has borne out the high hopes by which the drying movement was originally inspired. His main conclusion is that up to the present only about 25 per cent. of all the dried grass produced has been of the very high feeding value which (according to the early researches of Woodman and others) should be attainable. This rather disappointing result is due almost entirely to the fact that the output of most of the drying plants has been appreciably less than had been anticipated, so that the difficulty of dealing with the spring flush of grass has been still further increased. Moreover the expectation that, provided it was cut at a corresponding period of growth, grass dried in the autumn would be equal in quality to grass dried in the spring, has not been borne out in practice. Notwithstanding these disappointments, however, Roberts considers that grass drying has come to stay; and looks forward with some confidence to the gain in efficiency which would arise from developments both on the engineering side and in pasture management.

In the light of these conclusions Dixey and Darke's paper is of great interest not only on account of the very detailed costings which it gives, but because it provides a picture of how the process itself is working out on the farm. The most important general

difference between practical grass drying in 1937 and in the former year lies in the much lower outputs obtained. The six driers considered in this particular section of the paper produced an average of only 70 tons of dried material apiece, compared with an average of 179 tons from five more or less comparable plants in the previous year. In part this difference was due to an unfavourable season—an unusually pronounced spring flush followed by a summer drought; but in the main it is considered that it reflects an important change of outlook in regard to grass drying policy as a whole. In particular, the original ruling principle, that the drier must be kept busy at all costs throughout the season, appears to have gone. Drying costs were, on the whole, no lower than in earlier years; but against this must be set the fact that a rather high standard of quality was maintained, while, presumably, if overall costs have not risen although the output of the drier has fallen by nearly two-thirds, some improvements in efficiency or management must have been achieved. Individual costs varied very widely: from rather under £4 to well over £8 per ton of dried material. It does not follow, of course, that the material produced on different farms was at all comparable in quality; in fact, it is fairly clear that, when everything else has been taken into consideration, the cost of the final product depends mainly on what particular product has been aimed at. This is borne out by the remarks of the various speakers at the Conference already referred to: they were quite sharply divided into two groups, those who aimed at producing, with some certainty, a material rather better than hay at its best, but not by any means a concentrated food; and those others who aimed, not always successfully, at something like the highly concentrated foodstuff envisaged by Woodman. In practice these two points of view represent the alternatives of cutting moderately long material, which is left to wilt for some hours before collection, or of keeping the drier constantly supplied with short fresh-cut grass. Dixey and Darke consider in some detail all the many points which arise in deciding between these alternatives and conclude that, while the production of really high-grade dried grass is attractive on account of the high prices ruling for the relatively small quantity available, the wilting method offers the greater chance of bringing grass-drying into ordinary farming. According to their experience, the most successful users of grass-drying plants have, up to the present, been those whose attitude has been "Go for cheapness first, and improve the quality as you may." In particular they deprecate the conception that grass-drying has no value except as a source of protein: it may be possible to produce a relatively cheap product which is still appreciably better even than really good hay and, at the same time, to purchase the protein which it lacks, in comparison with

higher grade material, more cheaply than it can be produced on the farm. One other point brought out in this paper is that attempts to avoid the difficulties of pasture management by growing forage crops specially for the drier have not so far offered much promise of success, partly on account of the high moisture contents of the crops and partly because of their relatively high cultivation costs.

In the U.S.A. forage drying appears to be developing almost exclusively on factory lines. In a paper based on the results of a survey made on behalf of the A.S.A.E. Committee on Forage Drying, Hurst (Ref. 37) gives a summary of the distribution, type and 1936 output of some 40 plants. It is suggested that these probably represent about half the total number of driers operating in the States and that the total output in 1936 was of the order of 100,000 tons of dried material. By far the greater part of the output was lucerne dried for sale as a constituent of manufactured feeding stuffs; and most of the driers were rotary plants with capacities of from one to five tons of dried material per hour.

If grass drying in England is, indeed, to settle down on the lines suggested by Dixey and Darke, and we are to concentrate on producing a material better, but not a lot better, than good hay, it is clearly pertinent to enquire how nearly we may approach the same object by improvements in haymaking technique. In fact, from the National point of view the latter would appear to be much the more important problem; for in no circumstances can we expect artificial drying to deal with more than a very small proportion of the total grass cut for winter storage, and if large quantities of hay are still to be produced there is an enormous potential gain to be made by improving its quality, if only to a relatively small degree. The American paper mentioned above makes the same point: "Unless very rapid progress is made in the development of driers . . . the bulk of our hay crops will continue to be dried in the field. While research activities in field curing may not return as spectacular or fascinating findings as in artificial drying, possibly greater immediate benefits will result to the average farmer." With these considerations in mind a paper by Cashmore (Ref. 4*a*) on the production of higher quality hay is very much to the point at the moment. After discussing the main reason for loss of quality in ordinary haymaking this writer concludes that, provided that over-drying or bleaching can be avoided, the best hay will be that for which the interval between cutting and carrying is shortest. He goes on to explain the sort of way in which natural drying takes place in the field, using as illustrations some experiments in which moisture-content determinations were made at all stages between cutting and carrying. The hay concerned was treated in four

different ways: some was left untouched in the swath throughout the drying period; some was left untouched for 48 hours and then tedded; some was tedded immediately after cutting; and finally some was tedded immediately, put up in windrows over-night and re-tedded in the morning. In each case drying took place much more rapidly, and also more uniformly, after tedding: in fact, in the long run, immediate tedding saved at least two days drying time by comparison with the untouched samples. Another feature of interest was the fact that, although conditions at the time of the experiments were ideal for haymaking, the moisture contents rose appreciably over-night, the rise being greater the drier the hay. Thus, starting from a moisture content at cutting time (10 a.m.) of 72 per cent., the untouched and tedded portions had reached moisture contents of 53 and 35 per cent. respectively at 6 p.m. on the same day. By 6 a.m. on the following morning, their moisture contents had risen to 60 per cent. and 51 per cent. respectively, although conditions were favourable over-night. When the hay was put up into windrows over-night, however, the reabsorption of moisture was considerably reduced, so much so that in the sample treated in this way the moisture content on the following morning was only 42 per cent. The final result of all this was that, taking a moisture content of 25 per cent. as being just low enough for stacking, the tedded and windrowed portion was thoroughly fit to carry early on the afternoon of the next day after cutting: while the tedded portion was ready later on the same day, but not early enough for any carrying actually to be done. As for the untedded hay, the lowest moisture content reached on the day after cutting was about 43 per cent. and it was still unfit to carry by the end of the next day again. The moral to be drawn from these results is that even in the most favourable weather it is not sufficient to leave the drying entirely to Nature: much can be gained by giving her a helping hand. Cashmore, however, takes the matter a step further by considering how much more could be gained if hay could be carried at, say, 35 per cent. moisture instead of 25 per cent. The gain is two-fold because, in any weather conditions, it is the later stages of drying that are the slower and more difficult; while in humid day-time conditions, or in the event of delay over-night, it is the driest hay which reabsorbs the most moisture. He goes on to consider field baling as a means of achieving the desired object and also of attaining a still higher-quality product by avoiding the excessive heating that only too often takes place in the stack. Without going into the many matters of detail—such as the relations between moisture content, baling density and maximum bale temperature—which are discussed in the paper, the general case for field baling can be put as follows: with ordinary methods of hay-making, as practised in the South of England at any rate, a farmer has in

any case to effect a compromise between two main sources of loss of quality and, in many cases, has to suffer both. These are, losses through respiration and bleaching during the drying period; and losses through overheating in the rick. By allowing the hay to be taken home at a higher moisture content, baling shortens the drying period and so reduces the losses during drying; moreover since the hay, even when put up in a fairly green stage, heats less intensely and for a shorter time in a bale than it would do in a stack, the heating losses are also reduced. More experimental work needs to be done before the baling process and subsequent storage can be regarded as fool-proof; but the analyses of Cashmore's experimentally baled material, which in some cases nearly reach the standards laid down for the lower grades of dried grass, are proof that the process is worth following up. In two other papers the above experiments on field drying are given in more detail, while the practical side of baling is also discussed (Refs. 38 and 39).

It will no doubt be realized that the principles underlying the field baling development are closely allied to those which, generally without being stated in so many words, govern the methods of haymaking commonly practised in the North of England. Another development in the same direction is provided by an ingenious French machine which has been described recently (Ref. 40). This machine travels along a windrow and rolls up the hay into tubular bundles which, by comparison with the windrow itself, offer a greater drying area to a favourable wind and are also more weatherproof. This device is mainly intended for dealing with lucerne and similar crops in which the difficulty of drying out a sappy stem is increased by the necessity for avoiding loss of leaf through too much handling. If the weather is unfavourable it is used in conjunction with a kind of vertical windlass, which is attached to the cutter bar of the mowing machine, and which combs out the cut material so that the stems lie more or less parallel to one another and at right angles to the direction of cutting. When the "Javelotteur," as it is called, is used on a windrow of this type the resulting tubular bundles are such that they can be stood up on end, loosely tied at the top if necessary and are said to be really weatherproof over a long period.

The third of the common grass conservation processes—silage making—has also been the subject of much discussion during the last year. Its advocates claim that in its modern form it is much cheaper than grass drying and considerably more foolproof than any haymaking can hope to be. Moreover, the resulting product can, if necessary, approach dried grass in quality. Against these advantages must be set the fact that it is not, on the whole, a very convenient process, especially from the point of view of

subsequent feeding. The comparative efficiencies of silage making by either the Molasses of the A.I.V. process, and the alternative methods of conservation are discussed by Watson (Ref. 4*b*), while the economic aspects of the three processes are dealt with by Bridges (Ref. 4*c*). Both papers make out a good case for giving ensilage more consideration in the future. In connection with these, two other papers, originally read on the same occasion, are of interest. In the first Sanders and Garner (Ref. 4*d*) discuss some preliminary experiments in silage making on Continental lines—that is, using a cheap portable silo in place of the more usual tower. In the other paper Farrant (Ref. 4*e*) discusses his own experiences as a farmer over many years. This paper brings out three very interesting points: first that, by comparison with those of an earlier generation, our haymaking methods in the South have tended—mainly through high wages and labour difficulties generally—to become less efficient; secondly that farmers are already realizing, quite apart from exact scientific reasoning, the merits of field baling and are using it to improve their hay; and finally that, although silage-making has all sorts of theoretical advantages on its side, it seems often, in practice, to be abandoned after two or three years working. Silage made from forage crops of all kinds has, of course, been an established feature of American farming for many years, and in the appropriate districts every farm is equipped with a tower silo and blower as a matter of course. It is interesting therefore to note that in America, too, the possibilities of grass silage are being considered. Hamlin (Ref. 41) discusses modern American methods of harvesting and handling grass silage and gives comparative costs.

Machinery for Root and Vegetable Crops.

By comparison with other branches of arable farming the growing of root or vegetable crops makes very heavy demands on labour both for planting or singling in the spring, and for harvesting in the autumn. Moreover, the difficulty of providing the necessary labour is all the more pronounced because there is an increasing tendency for these crops to be grown on tractor-worked farms where labour requirements for other purposes have been reduced to a minimum. At present the autumn labour problem is apparently regarded as the more urgent; or it may simply be that, by comparison with singling, the harvesting appears more hopeful of solution by mechanical means. At any rate, experimental machines for harvesting potatoes, sugar beet and similar crops are being developed at present in at least half a dozen different countries. A promising American sugar-beet harvester is described in some detail by Culpin (Ref. 42). Unlike most other experimental harvesters this one raises the beet without

previously topping them : in fact, after being loosened by a small share, the roots are pulled out by a pair of rubber-faced chains which grasp the leaves rather after the fashion of a mechanical flax puller. One advantage of this procedure is that, being pulled almost vertically, the roots are left with very little soil adhering to them; another is that the subsequent mechanical topping can be more accurately "gauged." Another special feature is that topping is done by a pair of discs which combine to make an inverted V-shaped cut, resulting in the loss of a minimum amount of sugar-producing root. It is claimed that, by comparison with hand-topped beet, this machine gains more by this V-shaped cut than it loses through imperfect adjustment of the height of cut. At present the machine cleans the beets and delivers them to a hopper from which they are finally dumped in heaps of about 2 cwt., but a further development towards direct loading into a trailer is now being tried. There would seem to be no reason why a machine of this type should not be modified so as to operate satisfactorily under English conditions. On the other hand relatively few sugar-beet growers could afford the high capital expenditure involved; so that the successful development of this or any other harvester would appear to depend on evolving some scheme of factory ownership.

By contrast with the above, the "Ultuna Method" of root harvesting involves only a minimum of capital cost (Ref. 43). The method is primarily intended for fodder roots, and topping is done while the roots are still in the ground, using a hoe device which has already been demonstrated at least once in this country. Uprooting is done by a sort of skeleton sledge, which is pulled by two horses and carries shares on the under-side, and which is said to be quite effective even on heavy land. It is estimated that, besides allowing the tops to be harvested in good condition for ensilage or direct feeding, this method saves about 30 per cent. of the man-labour required by ordinary methods of harvesting.

Huber (Ref. 44) discusses some of the defects of the various machines used in potato-growing. He regards planters as the best developed machines and confines his criticisms in regard to them mainly to fertilizer placement. Manufacturers advertise that their machines will put the fertilizer either above, level with, or below the seed; but in practice, unless the fertilizer is placed below, its theoretical distribution is likely to be completely upset by the passage through the soil of other parts of the machine. Seed spacing should be more easily adjustable on some machines, and rolling of the seed after dropping should be prevented. All these criticisms apply, of course, to fully-mechanical planters which are unlikely to become common in this country because of the growing practice of chitting. Huber regards the mechanical digger as the machine most requiring improvement. According

to studies made in Maine, mechanical diggers of the continuous-elevator type may damage as many as 17 per cent. of the tubers. This type of digger is very commonly used in the States but is virtually unknown here. On the other hand, according to a German article (Ref. 45), the more familiar spinner type of machine is also capable of improvement. Four types of spinner digger—including one power-driven machine, and one embodying a drum type of cleaning mechanism—were studied during the 1937 season. The main criticisms were, (1) that by comparison with hand lifting the machines gave a labour-saving of only from 20–30 per cent.; (2) that they left 10 to 15 per cent. of the tubers buried; and (3) that their mechanisms were, for the most part, too complicated. It is considered that by careful design the over-all labour saving might be increased to well over 50 per cent. and that the losses might be reduced to 5 per cent. A French article (Ref. 46) also reviews recent progress and speaks favourably of both semi- and fully-mechanical planters. One difficulty in France is that, in spite of the growers' descriptions, seed potatoes sold as graded to a certain size may when delivered turn out to be twice the size specified. Planting difficulties would be greatly decreased if home grading of seed was a more general practice. A simple grading device, which has also been mentioned elsewhere (Ref. 40) is described.

Electricity in Agriculture.

Rural electrification in general, and recent developments in the Dumfries area in particular, are discussed in a paper by Pickles (Ref. 47). Although the first part of this paper refers incidentally to the uses of electricity in horticulture, grass drying, and even in ploughing, it is mainly concerned with the requirements of the ordinary small mixed farm and, in consequence, contains few references to anything unfamiliar in the way of equipment. On the other hand the second part includes both a description of the working of the Dumfries County Scheme and some very courageous deductions therefrom; and these make it a very inspiring contribution to the general literature of Rural Electrification. The main feature of the Dumfries Scheme is that every customer has been treated equally, and has been given a supply without any contribution to capital cost and without the payment of any guaranteed minimum revenue. From the success of the Scheme Pickles deduces that, subject to the adoption of a suitable policy, it should be possible, even in an area with no more than 100 persons to the square mile, to provide 70 or 80 per cent. of the potential consumers with an efficient supply, and this without asking for capital contributions or guarantees of minimum revenue on the one hand, and, on the other, without fear of financial loss. Moreover the average cost

of connection, up to 75 per cent. saturation, should not exceed the cost of attaining a similar degree of development in a built-up area. This paper was read before a technical audience and the writer was presumably to some extent "trailing his coat" before them. On the other hand, there is no reason why members of the agricultural community should not use its arguments to good effect in their negotiations with local supply companies. In America it would appear that rural electrification has progressed rather faster than it has in this country. At any rate, American literature on the subject indicates a rather franker acceptance of the fact that the electric supply company is not a public benefactor but just a manufacturer with something to sell. One aspect of this point of view is illustrated by a paper in which Stahl (Ref. 48) describes the testing and educational services which one particular company had maintained for its customers for the past 15 years. This company operates in a district in which irrigation is extensively practised, so that its main concern is with the use of electricity for pumping. Over 11,000 individual tests of farmers' own equipment have been carried out entirely without charge to the consumer; and the result has been of benefit not only to the farmer in achieving a great increase in the overall efficiency of irrigation, but also to the supply company in providing basic information relating to the needs of the district. Again a paper by Kable (Ref. 49) indicates a very tolerant attitude towards wiring regulations and conditions: farmers in general are faced with difficult wiring situations coupled with the urgent need to keep down capital outlay. They should be educated gently into doing the best they can in the circumstances rather than be forced by strict regulations to attempt the almost impossible. Several papers on the educational side may also be mentioned (Refs. 50–52).

A review of the development of electrical soil heating is given by Rowland (Ref. 53) in a paper which also describes the standard equipment now available. He goes on to summarize the results of soil-heating experiments in various parts of the world from Scandinavia, where some of the earliest commercial uses of electrical heating were made, to America where, it is stated, soil heating has become a load of real interest to supply companies. Some English experiments previously reported in which "although the results obtained were promising, the general conclusion is that the operating costs were too high" are criticized on the ground that, for various reasons, the results are misleading. In particular Rowland suggests that the heat insulation was imperfect in several respects, while more efficient operation might have been obtained with less deeply-buried cables. On the other hand, one feels that the particular instances quoted in illustration of the benefits and economies of electrical heating are not very convincing

because they nearly all relate to special small-scale cases without reference to the general utility of the method for more general purposes. A rather more reasoned account of electrical heating is given by Cameron Brown (Ref. 54). He concludes that, for commercial glasshouse heating, electricity is out of the question except as an auxiliary which, in some cases, may add greatly to overall convenience. For soil heating in frames electricity offers much greater possibilities although, even here, very careful consideration of the best layout, and great attention to insulation and other factors, are necessary if the process is to be economical. In particular, the full advantages of electrical heating can be realized only if the maximum use of the hot beds is made throughout the year; the process is therefore more attractive to the nurseryman who can use it for seed pans, seedlings, cuttings and so on practically all the year round, than to, say, the lettuce grower who can use it effectively only for a relatively short time. For the latter type of user a maximum figure of ½*d*. per unit for current is a primary necessity. Brown goes on to refer to the use of electricity for soil sterilization and also to a novel method of applying artificial heat in tomato growing. The plants are grown on fibrous matting suspended over shallow tanks holding liquid solutions which contain all the nutrients necessary to plant growth. The roots of the plant extend into the tanks, the temperature of which is thermostatically controlled. This is not "soil heating," but "soil-less heating"; and large-scale confirmation of the very promising experimental results will be awaited with great interest.*

The last paper to be mentioned in this section deals with wind-electric plants, a subject of perennial interest about which little up-to-date information is available in this country (Ref. 55). It points out that while windmill generation can in no sense be regarded as a serious competitor where a mains supply can be secured, it makes the isolated farm quite independent of the customer-per-mile factor. The operation over a three year period of a 1500-watt plant on an isolated Iowa farm is described in detail; and the results are compared with test figures from several American sources. On a basis of 100 kW.h. per month the unit cost came out at round about 3*d*. This figure is appreciably less than some that have been estimated in this country but is nevertheless high enough to dispose of the idea that, since wind costs nothing, a windmill must be able to generate cheap electricity.

Miscellaneous.

An unofficial estimate puts the number of combine-harvesters at work in this country last harvest at 115 : a figure that is both

* *See also* under Soils and Fertilizers, p. 366.

high enough to suggest that the combine has come to stay, and low enough to make it quite clear that this machine is unlikely to supersede the binder (Ref. 16). Since recent increases in numbers have been very largely due to the introduction of the so-called "baby" combines, an American study of their efficiency in the field may be of interest (Ref. 56). This deals mainly with the grain losses in various parts of the machine and brings out several interesting points in regard to them. All the combines concerned were operating on commercial farms. The method adopted in each case was first to test the machine as it was operating when first visited and then to see what improvements could be effected by expert handling and adjustment. In some cases very high losses due to inexpert handling were found and cured: one machine for instance was losing nearly a quarter of grain to the acre; but adjustment raised its overall efficiency from 65 to over 90 per cent. As finally adjusted there was little difference between machines of different sizes or of different types. Moreover, really high efficiencies were not difficult to attain, although a process of compromise was generally necessary. Thus it was not sufficient to find that there was a high rate of grain loss in, say, the drum and to assume that this could be put right without affecting the rest of the machine. In fact over-correction of one particular source of loss nearly always led to increased losses somewhere else, with the curious result that, when adjusted to give the highest possible overall efficiency, each individual part was actually working at rather below its optimum performance.

The unusually severe late spring frosts of 1938 brought orchard heating into much prominence and incidentally made it clear that most existing systems were inadequate, as they stood, to deal with the exceptional conditions which prevailed. Much the same sort of thing was experienced in California in January 1937 and a study of the difficulties which growers then met has since been published (Ref. 57). The main troubles were very similar to those which growers met in this country: the usual methods of regulating, cleaning and filling heaters were inadequate; while the public protested vigorously against the smoke.

Another feature which made the 1938 spring a nightmare to growers of vegetable and fruit was the prolonged drought. A recent note deals briefly with the possibilities of overhead irrigation (Ref. 16) while some American papers on the subject deal exhaustively with both practical and technical points affecting the performance of sprinkler-type irrigators (Ref. 58–60).

One other modern development whose future depends very largely on progress in equipment design is chemical weed destruction. MacDowall (Ref. 61) points out that, in spite of many scientific papers on other aspects of the subject, chemical weed

eradication to the farmer means simply the use of either copper sulphate or sulphuric acid on cereal crops. Even this use of chemicals has not progressed as far as one might have expected for, up till now, less than 1 per cent. of our cereal acreage has been dealt with. The main reason is that equipment design has not kept pace with the rest of the development: most spraying machines are relatively expensive both in the first cost and upkeep, and they have not yet been properly adapted to tractor use. Once a spraying machine has been used it is liable to deteriorate through chemical action; and this deterioration takes place whether the machine is subsequently used or not, and almost regardless of any cleaning which a farmer can reasonably be expected to give it. Bates (Ref. 62) also discusses chemical methods in the course of a more general paper on weed destruction. He makes the point that sulphuric acid is not suitable for autumn use—as, for instance, in controlling chickweed in potatoes or bulbs—because the moist climatic conditions generally prevailing tend to minimize the dehydrating effect on which the use of the acid depends. He suggests, as an alternative, the use of a 2 per cent. solution of sodium chlorate at the rate of 80 gallons to the acre. Bates also outlines a very interesting possible method of tackling the bracken problem. This again depends on the use of sodium chlorate or possibly sodium arsenite but the solution, instead of being sprayed, is wiped over the cut surfaces left when bracken is cut by any of the bracken cutting devices now available. The solution is applied automatically by a sponge device attached to the machine, and preliminary experiments with a suitably-equipped scythe have given very promising results.

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FARM ECONOMICS.

I. Agricultural Policy.

The year just passed has brought about no very far-reaching changes in the economic position of home agriculture. It is true that the Government broke fresh ground with their Land Fertility Scheme, of which farmers were not slow to take advantage, but otherwise there has been little in the year's experience in 1937 other than the normal seesaws of supplies and prices, weather vagaries and the minor irritations and blessings of the farmer's life.

In the world of agricultural politics it has been a period of marking time, with the exception noted above, a time of looking round to assess the value of what has been achieved and a time of discussion of what is possible in the direction of further action.

As to the past, farmers are fully conscious, no doubt, of the immense amount of assistance which the State has provided in the last few years. Those who need a reminder may be referred to a special article, published in *The Round Table*, in which the value of Government assistance of the more direct kind is assessed at £40,000,000 a year, while there are the less tangible benefits resulting from market reorganisation, tariffs and quotas. The other side of the picture, the increases in farmers' costs, was outside the author's terms of reference (Ref. 1).

The future, of course, is still a matter for investigation, and perhaps the most important contribution has been the Report of the Delegates to the British Empire Producers' Conference at Sydney, N.S.W. The Conference was summoned to consider the claims of primary producers in all parts of the Empire to their respective shares in the world markets, of which, obviously, the British market is by far the most important, and to find a way by which the Empire producers might control

both the total supply and its allocation amongst their different members. The aim of the Conference, quite frankly, was to secure producer control of the marketing of all primary agricultural commodities, while the object of the British delegation, of course, was to maintain and to extend the position of the British producer in his own market. The position is well summarised in one of the resolutions proposed by the British delegation in the following terms :—

That this Conference recognises that it is the duty of the organised primary producers of the Empire to do everything possible to develop intra-Imperial trade, bearing in mind, in relation to the market in the United Kingdom for foodstuffs :—

(*a*) the necessity that the home farmer should have a remunerative market for his produce which will enable him to maintain the volume and character of his output at a level consistent with the full maintenance of the fertility of his land and of the well-being of the rural population;

(*b*) the limitations of absorptive capacity imposed by—

(1) existing purchasing power, and

(2) the probable decline of population in the near future;

(*c*) the bearing of national defence requirements upon the situation, and

(*d*) the extent to which the Overseas Dominions may deem it economically desirable to develop their secondary industries.

The resolution recognises the great complexity of the situation. On the one hand, there is the need of the home farmer for an expanding market if cultivation and employment are to be maintained as being socially desirable, while making the land, at the same time, a larger reservoir of food production for war emergency. On the other hand, there is the equal need of the Empire farmer for a bigger market if he is to maintain and to increase his absorption of home industrial products, which is the great hope for industrial revival. This, in brief, is the agricultural dilemma. The resolutions adopted by the British Empire Producers' Conference suggest that it can be resolved by co-operation amongst Empire producers' organisations to establish commodity councils, producer controlled and financed, upon the lines of the Empire Beef Council and the International Beef Conference set up under the United Kingdom Livestock Industry Act, 1937 (Ref. 2).

However, this problem of the control of food production has been approached by some investigators from another angle, the

view taken being that there are other interests to be considered besides those of producers. It is argued that Government assistance should be used to regulate not only the quantity of production, but also the kind of produce; that is to say the lines upon which the industry should develop, under price stabilisation schemes of one kind and another, should be consciously planned. The case has been stated generally, with reference to the utilisation of the land for national purposes, and particularly, with reference to its utilisation for agriculture, in papers delivered at the meeting of the British Association, by Dudley Stamp and Sir Daniel Hall, in which they argue the need for national planning (Ref. 3).

This question of planning comes up in another form in the investigations which have been going on for some time into the nutritive values of foods. In 1935, a mixed Committee of agricultural, economic and health experts was set up by the League of Nations, under the Chairmanship of Viscount Astor, to consider the relation of nutrition to health, agriculture and national policy. In its final report (Ref. 4), the whole field is explored, and an immense amount of evidence is recorded, bearing on the nutritional standards of different countries, the relation of income to food consumption, and even the influence of education on the standard of living. It is impossible here to do more than indicate the scope of the Report, but certain tendencies in food consumption may be noted by way of illustration. For example, the consumption of cereals per head is lowest in countries with high levels of real income, and in other countries the consumption of wheat is a rough measure of the people's income, for wheat is displaced by rye in European countries as the income level falls. As to meat, the evidence is in the opposite direction, and consumption rises with the income level. This statement, however, excludes Australia and New Zealand, the great meat-producing countries, where consumption is about double that of any other country. There is a marked difference in the preference shown by countries for the different kinds of meat; the Australians, for example, eat very sparingly of pork products, while amongst the Danes and the Americans the taste of mutton and lamb is hardly known.

But the decline in the consumption of cereals is not entirely a matter of national standards of living. In the western countries, the tendency everywhere is downwards. The Committee found that it corresponds to a genuine change in physiological requirements, the principal cause of which is the reduction in the expenditure of muscular energy, due partly to the increased mechanisation of industry and the reduction of the hours of work, and partly to the rise in the proportion of populations engaged in commerce or other quasi-sedentary

occupations. The general lessons of the Report, which agriculturists may do well to note, are that the changes in labour processes, the rising standards of living, and the spread of knowledge of the nutritive values of foods will tend to reduce the demand for cereals of all kinds and to increase that for meat, dairy products, poultry and fresh fruit and vegetables. The necessary qualification of this statement is that the natural tendency may be over-ridden at any time in any particular country by action dictated by political expediency. Apart from its direct value to farmers, the mixed Committee's Report is full of interest, and it is a very readable production.

Those interested in the nutrition problem as a whole may be referred also to a report of the British Section of the International Association for Social Progress (Ref. 5). Those interested more particularly in milk may be referred to a report by the National Institute for Research in Dairying on some experiments made for the Milk Nutrition Committee, to test the effects on the growth and health of school children by supplementing their diet with pasteurized and with raw milk. As a control, other groups of children received a supplementary ration of biscuits, and the general conclusion reached was that on the whole, the children getting milk supplements showed higher rates of growth than the corresponding groups having the biscuit supplement. At the same time, it was almost impossible to measure any differences in the nutritive values of raw and of pasteurized milk (Ref. 6).

Turning to the Dominions and the Colonies, where agriculture bulks far larger in national economy than in Britain, the problem of agricultural assistance is still in the forefront. In New Zealand, for example, the Government rather than a Producers' Board, has been the buyer of all butter and cheese for the past two years, at fixed prices substantially in advance of those which farmers were getting before. The produce thus acquired is then marketed by the Government at the prices prevailing from time to time. The arrangement seems to have worked well from the farmers' point of view, but whether it is sufficiently flexible to enable the prices paid to be adjusted quickly enough to meet any considerable changes in the general price level remains to be seen, nor is it clear what would happen if the Government should be landed with a quantity of produce, owing to any falling off in demand or interference with shipments.

In the colony of Kenya, which except for a little mining is entirely agricultural, there has been a good deal of depression, and in 1936, the Farmers' Conciliation Board was set up, invested with powers for the assistance and relief of farmers. It is composed of representatives of the Government, of the Banks, and of persons of experience in agriculture and in commerce. Funds

are provided for the operations of the Board by the Governor in Council, and these are administered by the Land and Agricultural Bank of Kenya, as agents for the Board in making advances to farmers. Briefly, the Board is authorised to make advances to farmers who are insolvent, or who are being pressed by their creditors, or who are unable to carry on with any reasonable prospect of success through shortage of capital. Applications are made to local committees of the Board, and those which are granted must be published in the Gazette. At the same time, all judicial proceedings of any kind against the farmer are automatically stayed, and his property becomes vested in the agents of the Board. Advances are then made to enable the farmer and his family to live and to carry on their farming operations up to a maximum of 70 per cent. of the average annual produce of the farm. Receipts from all sales are paid to the agents, who use the money for the repayment of the advance and interest, for Crown taxes and local rates, for rents payable, in that order of priority, and afterwards in payment of other creditors as prescribed.

The Ordinance has some resemblance to the abortive scheme for giving farmers in England credit against the security of chattel mortgages, under the Agricultural Credits Act, 1928. In Kenya, however, the scheme has proved popular with farmers, and very considerable sums have been advanced under its terms (Ref. 6A).

But the problem of agricultural organisation and development to-day is not confined to the countries of the British Empire. In France, for example, which still maintains a rural population of some 40 per cent. of the total, and most of them peasants, the struggle between the agrarian and the industrial interests, which was settled nearly a hundred years ago in Britain in favour of the industrialists, is still going on. The need for a highly productive agricultural industry in a country with a political history such as that of France is obvious, but the difficulty of securing it under a peasant organisation is very great. The subdivision of holdings consequent on the law of succession has reduced the farming unit to a point at which the standard of living afforded is often very low, and producers on these holdings are cut off from many of the advantages of machinery and other aids to economic production. Against this may be set the spirit of co-operation for mutual protection in French peasant agriculture, a spirit that has no parallel of any kind in our own country. The French cultivator is insured against fire, livestock mortality, hail, accidents at work, etc., by applications of the principle of mutuality, while there is an agricultural credit structure of immense proportions, based on the same principle, which ramifies throughout the country. This mutual insurance

is organised in three stages, the local societies, the regional or departmental re-assurance institutions above them, and these last grouped in the *Caisses Nationales*. For insurance against mortality amongst livestock, for example, there are some 7,000 local societies reassured with 70 regional institutions, which are in their turn reassured nationally by two separate institutions. Insurance of this type is far cheaper than anything of the kind available commercially.

Mr. Neil Hunter's economic analysis of French peasant agriculture to-day illustrates at once the weakness and the strength of communities of small holders—their weakness in economic production for a competitive market owing to the small scale of their operations, and their strength derived from combination for their mutual advantage, arising out of the greater uniformity of their circumstances (Ref. 7).

The importance of this high degree of social and economic equality in a nation, as a factor in agricultural organisation, is apparent again from Dr. Jensen's economic analysis of Danish agriculture. At the time when great economic changes were overtaking Britain, the political power lay in the hands of those identified with inclosure, the engrossment of holdings and the development of capitalist agriculture. In Denmark, on the other hand, it was the policy of the State to preserve the peasant population and their holdings, and gradually to educate its people in the methods of business farming. Although the large farms were broken up, excessive subdivision was avoided, and the principles of mutuality were developed to include the processing and distribution of farm products. At the same time, as Dr. Jensen points out, and as some of our own agricultural reformers would do well to remember, the results achieved by the agricultural organisation of Denmark owe a great deal to the opportunity of trade with other countries of Western Europe (and particularly our own) which were more highly industrialised, and were densely populated with people living in urbanised communities occupied in industrial work (Ref. 8).

In America, an immense organisation for farm credit has been built up, and it must be regarded as a permanent and very important part of American agricultural policy. It dates from the Constitution of the Federal Farm Loan Board under the Federal Farm Loan Act of 1916, and the first action of the Board was to grant mortgage credit to a few farmers in Kansas. Since that time, one of every eleven American farms has carried or is carrying a mortgage loan from a Federal Land Bank, and the original scheme has developed, after many vicissitudes, into a great chain of credit associations supplying credit on mortgage, credit for financing production and credit for marketing and

miscellaneous purposes, all of them administered under a Government Department at Washington (Ref. 8A).

Farm Management.

The practice of farm book-keeping, always irksome to the farmer, is spreading, but it is probable that its increase reflects more the need for information to put before the Income Tax authorities, the Marketing Boards and others, than an appreciation of what it can do to assist in economical farm management. It is none the less a fact that accountancy affords the only measure of farming efficiency upon which any reliance can be placed. The analyses of farm management, recorded subsequently in this section, all of which are directed to show in what directions lie the strength or the weakness of the farming systems or practices to which they apply, are based on farmers' records, and it may fairly be claimed by economists that they could be of far more service to the industry, with the resources at present available to them, if the practice of farm accountancy, and of record-keeping of all kinds on the farm, were even more general. The case for the educational value of farm accounts has been very clearly stated by J. Wyllie, in a paper published by the South-Eastern Agricultural College, and it may be recommended to those who are still hesitant (Ref. 9).

1. *Regional Studies.*

(*a*) *Eastern Counties.* For many years the Farm Economics Branch of the Department of Agriculture at Cambridge has studied the organisation of agriculture in the Eastern counties. More recently, certain districts, selected on a geological basis, have been studied to provide evidence of the changes in farming fortune year by year. These districts are the loams of central Norfolk, the boulder clay where Essex and Suffolk join, the London clay in southern Essex, and the chalk country in Cambridgeshire. The latest report, prepared by Dr. R. McG. Carslaw, compares the financial position of farmers in these areas in the years 1936 and 1937. He found that the latter year had been the less favourable, and on the average, farm profits fell by no less than 20 per cent., or 6*s.* 6*d.* per acre. The causes of the decline in each district are analysed, and the chalk lands make the best showing in either year. The value of reports such as this lies in the analysis which they make of success and failure. If the good prices of the barley crop accounted for the steady returns in south Cambridgeshire, if the poor yields of wheat brought a low return in north Essex, and lower incomes from poultry and potatoes depressed the returns from south Essex (to take a few examples), farmers are at least equipped

with a knowledge of the causes contributing to their position in any year. It is for them to consider how far this knowledge can be applied to making adjustments in their practice (Ref. 10).

The same author, in collaboration with P. E. Graves, has made a running study during the past six years of the changing organisation of arable farming in East Anglia. Whereas the report just dealt with may be said to be the economist's contribution to the possibility of reorganisation on the farm, the present report is a measure of the farmer's response to his changing economic environment. Shifts from one type of production to another, the introduction of new machinery or new designs for pig-sheds, or the installation of a water supply, may all of them, in varying circumstances, contribute to the better utilisation of land, capital or labour. But the report suggests that the effect of small adjustments may transcend any of these in their contribution to the financial results of farming. To Mr. Gladstone is attributed the saying that, in public finance, "no one is worth his salt who will not condescend to save candle-ends and cheese-parings," and the authors of this study of East Anglian farming are insistent upon the value of "the combined effect of innumerable small adjustments in almost every phase of the production process" (Ref. 11).

(*b*) *Yorkshire.* From the Department of Agriculture at Leeds comes a first report on Yorkshire Farm Accounting Studies, prepared by W. H. Long and his colleagues. Records were obtained from 144 farms, which were divided for the purposes of study into twelve types, according to their character and location. Statistical data of valuations, cropping, receipts and payments are supplied, and the report is intended to serve as a basis for comparison in future years (Ref. 12).

(*c*) *Devon and Cornwall.* Somewhat similar is a report by R. Henderson on the results of farming on 74 holdings in these counties. This work has been going on for some time, and certain comparisons and conclusions are now possible. The report may be commended to those interested in farming in the West Country (Ref. 13).

(*d*) *Dorset and Hampshire Smallholdings.* Those who are interested in the problems of land settlement may be referred to a series of papers published in the *Journal of the Ministry of Agriculture*, by E. Thomas, containing financial data for the costs and returns of County Council smallholdings in Dorset and Hampshire. Dairy holdings formed the largest group, but the market gardens and fruit holdings ran them close, with poultry farms and mixed holdings a long way behind. Very few of the tenants were of more than fifteen years' standing, and

a considerable proportion of them supplemented the incomes from their farms with some other occupation. As to the success attending the efforts of these small cultivators, the best results were shown by the dairying holdings, with the poultry holdings following, and the market gardens and fruit holdings last. These results were for the year 1936 (Ref. 14).

(*e*) *Scotland.* From over the Border come four reports, three of them from the Economics Department of the Edinburgh and East of Scotland College of Agriculture, on the financial results of certain types of farming on the Border and in the East of Scotland, and the fourth a compilation by the Department of Agriculture for Scotland on the profitableness of farming in Scotland in 1935/6 (Refs. 15–18).

2. *Product Studies.*

(*a*) *Milk.* Milk production is the most important of the livestock industries of the country. Although it is concentrated in certain areas, there is no part of England in which dairying in one form or another is not carried on. While fresh milk, owing to its perishability, is one of the very few commodities in which the home producer has not to meet overseas competition, the fact that a considerable proportion of the production has to be manufactured into butter, cheese, etc., in open competition, has the effect of lowering the average price; it follows that all the information that can be produced about the economical production of milk is of great importance to those engaged in dairying. It is not surprising, therefore, to find that much of the work of the research and advisory centres is directed towards the study of the economics of milk production.

The most important is that which is organised jointly all over the country under a grant from the Milk Marketing Board. Concerted action on a common plan in all the advisory provinces of England since the autumn of 1934, has produced a volume of data such as was never before available; it has been assembled at the Agricultural Economics Research Institute, Oxford, for publication, with the authority of all those concerned in the work. Two reports have been issued, bringing the results of the investigations up to the autumn of 1936, and they deserve the careful study of all those engaged in milk production. The authors of the reports are careful not to claim too much for them. The number of farms studied, though large in itself, is only a small sample of the whole, and when this sample comes to be classified by dairying districts, sizes of farms, etc., the group numbers are not very large. Nevertheless, the intrinsic value of the data is such that a good many useful conclusions can be drawn. As is usual, when accurate informa-

tion is available, some popular notions are apt to be upset. It is usually supposed, for example, that the milking machine leads to economies in production costs. These reports make it clear, however, that although the labour cost was cut in machine-milked herds, the other items of cost increased, and the net farm cost of milk was nearly $\frac{1}{2}d.$ a gallon more than in hand-milked herds. Of course this is not the end of the story. On many of the farms using the machine, costs might be even higher under hand-milking owing to lack of competent labour, and there are other considerations affecting the comparison which are dealt with in the reports. Some other results show that milk yields are higher in small herds than in large ones, but so also are labour costs. But perhaps the most important point that emerges from the work is the effect of the proportion of home-grown foods to purchased foods in the cost of feeding. On farms on which the greatest reliance is placed on home-grown foods, and in years in which home-grown foods, hay and roots, are abundant and cheap, feeding costs are low. Net costs of level delivery producers were $\frac{3}{4}d.$ a gallon higher than those with non-level delivery contracts, and an examination of the costs in accredited herds shows that they exceeded those non-accredited by about $\frac{1}{3}d.$ per gallon. As to the influence of milk yield on costs, it is interesting to note that costs per gallon fell as yields rose, up to 2·25 gallons per cow per day. Beyond this point, the extra cost of the increased production exceeded its value. If these results are confirmed in later years, it looks as if the 800 gallon cow represents the economic level of production (Ref. 19).

On the production of what is sometimes called "category" milk, a paper was read to the members of the Farmers' Club by J. R. Currie, based largely on the experience gained at Dartington Hall. It deals with problems confronting the producer of tuberculin-tested milk, such as the extra labour, cowshed equipment, replacement of reactors, tuberculin tests, etc., the total of which were found to be about 7*d.* per gallon. There is a great deal of evidence on the details of cow-keeping which is valuable reading, though some of it may arouse doubts, as, for example, the statement that an expenditure up to £35 per cow for housing equipment, complete with water bowls, milking-machine attachments, etc., is justifiable (Ref. 20).

A group of local investigations of the cost of milk production, or of some items in the cost, may be mentioned. They were undertaken by the Departments of Agricultural Economics of the Universities of Manchester (Ref. 21) and of Leeds (Ref. 22), the Departments of Economics of the Seale Hayne Agricultural College, in Devon (Ref. 23), and the South-Eastern Agricultural

College, at Wye (Refs. 24 and 25). One of the Wye reports, dealing with the increase in milk production in recent years, is based on the county statistics; these are, no doubt, the best evidence available, but they are apt to be misleading when used for producing maps to show the density of the cow population by shade differences. The abrupt changes thus indicated as one crosses from Cheshire into Shropshire or into South Lancashire, for example, or from Dorset into Somerset, have no real significance.

A Farmers' Report from the West of Scotland Agricultural College follows a form which might be used more extensively in advisory work. It is an analysis of the feeding costs in milk production, on some 57 farms, for the year ending October, 1937. The farms are arranged in groups to make them roughly comparable, and the results for each farm are then tabulated. Every farmer participating gets a copy of the figures, and he is thus enabled to compare his own feeding rations, home-grown and purchased, his own feeding costs for both, his cows' milk yields, etc., with those of other herds falling in the same category. It is not to be inferred, of course, that he can necessarily cut his costs to those of the lowest, or that he can increase his milk yields to those of the highest, with profit to himself; but the differences disclosed should attract his attention and set him thinking (Ref. 26).

(*b*) *Sheep.* For some reason, the sheep industry of the country, important though it be, has attracted very little attention from the farm economist. In arable districts, of course, farmers do not seem to have needed any proof that the time-honoured methods of hurdling sheep were often uneconomic, and the arable breeds have suffered accordingly. Many farmers will say that the land has suffered too, but this again has never been the subject of scientific investigation, and it is quite certain that many a spring corn crop used to go in very badly behind a late and sticky sheepfold. No one has made any serious study of the extent to which the roller and artificials could be made to replace, at less cost, the golden hoof and the fold-tail.

As a preliminary to more systematic research, a rapid survey of changes in sheep-breeding in the arable areas was made by R. P. Askew, and his short report, which appeared in the *Journal of the Ministry of Agriculture* in 1937, is full of interest. That there has been a decline in the total number of sheep in England and Wales is well known, and it is generally surmised that the fall has been confined largely to the areas of arable sheep farming. Some of the changes which have occurred, however, will be astonishing to many, when stated statistically, as in this report. Here, for example, are the changes in the numbers of

registered flocks of the four most important Down breeds during the past 25 years :—

Numbers of Registered Flocks of Four Down Breeds in 1910 *and in* 1935.

Breed.	1910.	1935.	Decline.	
			British Isles.	England and Wales.
			per cent.	per cent.
Hampshire	490	169	−65·5	−65·5
Southdown	359	192	−46·5	−46·5
Oxford	175	97	−44·6	−65·3
Suffolk	246	340	+38·2	−13·5

In England and Wales all have fallen heavily and, except for the Suffolks, which are now very popular over the Border, for crossing, in the British Isles too. Grass sheep of a great many breeds and crosses have displaced the pure Down flocks, and these are crossed with Down rams, the Hampshire and the Suffolk being by far the most popular. The practice of cross-breeding is spreading, and an analysis of the lambs on offer at Marlborough Fair during the three years 1933–5, shows that about 82 per cent. were crossbreds. The problem before the cross-breeder is that of flock maintenance, and the change from the pure-bred to the cross-bred flock is still too recent for standardization of type or method to have been carried very far (Ref. 27).

One of the financial studies of farming which have been pursued at Wye, by J. Wyllie, is concerned with sheep husbandry, and the problems involved are discussed by him in a recent report. They are discussed irrespective of breed, to show the financial results of sheep keeping on 16 farms during the seven years ended in 1936, and a brief description is given of the records and accounts needed to show the returns both for breeding and fattening (Ref. 28).

(*c*) *Pigs.* Comparatively little information, too, is available about the economics of pig keeping. Reports on two local studies have recently been issued, however, from opposite sides of the country. A report from Cambridge deals with the eastern counties, and two others, from Seale Hayne Agricultural College, relate to Devon and Cornwall. The Cambridge investigation, covering the year ended March, 1937, showed that the business of pig-keeping as a whole was satisfactory, the rise in feeding stuffs in the latter half of the year having been set off by the rise in pig prices. Until the breakdown of the Pigs Marketing Scheme, pigs sold on the open market made more than those contracted to the Bacon factories, and though the position was

afterwards reversed, factory pigs averaged 5*d*. a score live-weight less than those sent to market. Some interesting statistics of birth and mortality were procured. The average number of pigs born alive in all herds was 9·7 per litter, and of these an average of 7·9 were weaned. Over-lying by the sow accounted for 52 per cent. of the pre-weaning deaths. Summer litters were larger than winter litters by one pig each, and the herd replacement figure was about 25 per cent. in the year. As to breeds, the Large White accounted for 70 per cent. of the sows, while the rest were distributed equally between (*a*) the Middle Whites, (*b*) the Essex and Wessex, and (*c*) various other breeds and crosses. Amongst boars, the Large Whites were even more popular, being 90 per cent. of all boars used. All herds made profits. An analysis of those in which the profits were low showed that the main causes of avoidable financial loss were :—

(i) A high ratio of food consumption to live-weight increase.
(ii) Expensive rations.
(iii) High mortality rates.
(iv) Excessive labour costs.

This report is full of information of value to the pig breeder and feeder (Ref. 29).

The Farm Economics Branch of the Cambridge University Department of Agriculture has also issued a Farmers' Bulletin on management in pig production, which contains much useful advice to pig breeders based on the experience gained in the research work of the branch (Ref. 30).

Reports from Seale Hayne cover each of the years 1936 and 1937. They confirm the Cambridge results in that all pig producers in the one year, and all except two in the second year, made profits, the average being almost identical with that in the eastern-counties investigation. There were wide variations, however, between farm and farm, which show very clearly how much the financial results of farming are due to matters within the farmer's own control, and that the Government must not be blamed for all the failures. The preference in the far-western counties for breeding stock differs very considerably from that in the eastern counties. In the Devon and Cornwall inquiry Large Whites accounted for no more than 34 per cent. of the total, the Wessex and Essex 26 per cent., while the Large Blacks, once so popular, which figured amongst the "also-rans" in the Cambridge returns, account for some 25 per cent. of the sows in the west of England investigation. The Cornish Lop-eared numbered no more than 5 per cent. Turning to the boars used, however, the Large White breed was triumphant, being the only one found on these farms (Refs. 31 and 32).

(*d*) *Poultry.* Poultry keeping has been under a cloud in the last year or two. High mortality rates and rising costs of feeding stuffs undoubtedly have hit poultry keepers hard, but there is less substance, probably, in their claim that they have had to face increasing competition from overseas, for prices on the whole have been well maintained. So long ago as October, 1935, a Poultry Technical Committee was set up to consider mainly the supply and distribution of hatching eggs, day-old chicks and breeding stock, with particular reference to the reduction of poultry mortality. This Committee concluded its work in 1937. The Committee found ample evidence to satisfy itself of the profound importance of the incidence of mortality in its effects on the economic position of the poultry industry. Briefly, this position was attributed by the Committee to the unprecedented rapidity of the expansion of the poultry population, under the stimulus of high egg prices. The rise in the scope and importance of the industry has not been accompanied by a commensurate increase in scientific research into poultry diseases. To meet the situation, the Committee recommended the establishment of a Poultry Commission with statutory powers to secure the compulsory registration of all distributors of hatching eggs, chicks or stock, and to refuse or to withdraw registration in unsatisfactory conditions. Other recommendations include provision for research into urgent problems of poultry mortality, and for educational and advisory work amongst poultry keepers (Ref. 33).

Local studies on the financial results of poultry farming have been made in Yorkshire, at the University of Leeds, in Wales, by the Department of Agricultural Economics at Aberystwyth, and in Scotland, by the Economics Department of the Edinburgh and East of Scotland Agricultural College. In the Leeds investigation, poultry keepers are considered in two groups—those who are mixed farmers and those who are specialists. Egg producers on mixed farms were uniformly successful whereas the specialists were generally unfortunate, and the causes of success and failure are analysed in the report (Ref. 34).

H. J. Smith's study of poultry-keeping, both for eggs and table, in Wales is presented in the useful form of comparative results from all farms; each producer can therefore compare his standards of efficiency with those of his fellows. The comparisons tabulated include the capital invested and its distribution between equipment and livestock; costs of food and labour; receipts from eggs and birds; and, of course, profits and losses. All of these results are expressed both per bird and per 120 eggs produced (Ref. 35).

The Scottish report reviews the whole position of the poultry industry at the end of the year 1937, and this is followed by an

analysis of financial results of twelve specialist poultry farms during the year (Ref. 36).

(*e*) *Crops.* Crop husbandry as a whole is declining year by year with the dwindling arable acreage, but the incidence of the decline varies very much for different crops. Stimulated by the extension of the quantity of wheat to which the full guaranteed price may apply, wheat growing continues to expand. The newer methods of handling grain crops, therefore—the power-driven binder, the harvester-thresher and its complement, the grain drier—are of increasing importance, and the study of the economics of their application to English conditions which has been going on at Oxford for the past three years, is of importance to arable farmers. The farms studied are above the average in size, running up to 1,000 acres; livestock upon them is generally unimportant; and the use of horse labour has been almost entirely eliminated. Wheat is the principal corn crop grown. The costs of harvesting by combine averaged over the three-year period about 17*s.* an acre, and from 3*s.* to 5*s.* a quarter, according to yield. Sweeping and ricking the straw varied little in cost under the different methods employed, and ranged from about 3*s.* to 5*s.* an acre. Total harvesting costs by the combine, therefore, may be said to have been round about 21*s.* an acre. Where the self-binder was used, costs averaged about 27*s.* an acre, but this does not represent the full advantage in favour of the combine method, for by it the harvest was carried out more expeditiously, without hindrance from the weather, and thus with more efficient use of labour. The authors of the report point out that some serious technical difficulties in mechanised grain production still remain to be solved, the chief of which is the possibility of maintaining soil fertility without animal manure. So far, there is no reason to doubt that it is possible; indeed, with adequate cultivation, the use of well-balanced artificial fertilizers and ploughing in occasional green crops, it seems that much light corn land might yield even better than in the past. A difficulty not so easily disposed of is the unequal demand for labour throughout the year on the highly mechanised farm. Some of the farmers are experimenting with livestock, particularly pigs, and the preliminary results are promising. It is quite possible, however, that further experience may show that the occurrence of slack time at certain seasons must be accepted as incidental to this type of farming, and that it will pay the farmer better to carry his labour, work or play, rather than to diffuse himself on other enterprises which may or may not be profitable. This, however, is outside the scope of the report now under consideration which should be studied very carefully by anyone who is thinking of adding a combine-harvester to his farming equipment (Ref. 37).

The prospects for dried grass continue to interest many farmers. In this country, haytime and harvest have very seldom failed, but the combine-harvester and the grass drier offer very attractive alternatives to the older processes, given that the economics of their use can be justified. The grass drier has suffered, like many a new invention before it, from the enthusiasm of its introducers. But if it has not fulfilled all that was claimed for it, the process is too convenient in its independence of weather conditions, and the product is too valuable in its food content and palatability, for it to be lightly dismissed as impracticable or uneconomic.

Research begun at Oxford during the season of 1936 was continued in 1937, with the result that grass-drying may be said to offer considerable possibilities along lines which, though less spectacular than first projected, appear sufficiently attractive. The position is typical of a new process in its earlier years, and it reflects the fact that farmers are doing what they can to fit it to their conditions. Great variations in cost were found during the 1937 season. Cutting first and picking off the ground later was found to be cheaper than cutting and collecting in one operation, nor was there any serious loss, either of protein or of carotene, in grass which had been left on the ground. It was apparent that there was still room for improvement in the construction of some of the furnaces. The quantity of fuel required to evaporate the moisture in the grass cannot be reduced below a certain minimum, but until that minimum is approached, the design of the plant, so as to secure the more efficient use of heat, must have constant attention. The need is for a machine the costs of which will compare with other farm equipment, so that grass drying may be a farming rather than an industrial process. These are a few of the points made in the report on grass-drying progress by R. N. Dixey and W. F. Darke (Ref. 38).

The nutritive value of dried grass, and its place in the rations of farm animals of all sorts was the subject of a report prepared for the Grass Driers' Association by Dr. S. J. Watson, of the Imperial Chemical Industries Research Station at Jealotts Hill. The object of the publication, presumably, is to advertise the value of dried grass, but it contains the best summary of experimental work in feeding this product that is available to the farmer (Ref. 39).

3. *Labour.*

From a former head of the Statistical Branch of the Ministry of Agriculture comes a study of the agricultural labour bill in England and Wales, presented in the form of a paper to members of the Royal Statistical Society. This is not a publication intended to assist farmers in their labour organisation, but the

analysis which R. J. Thompson makes of the different categories of farm workers, adult and juvenile, male and female, regular and casual, their numbers, average weekly earnings, and the total labour bill, is authoritative and instructive. The total numbers of workers of all classes at the time of the last Census, 1931, was 715,000, and he estimates that their total earnings for the year were £52,584,000. The figures have declined during the past seven years, but the importance of agriculture in national life as an occupation is obvious (Ref. 40).

Marketing, Prices and Supplies.

1. *Marketing.*

A good many reviews of the methods and of the results of State intervention in marketing policy have appeared since the period of great activity in agricultural reorganisation following the passing of the Marketing Acts. At a meeting of the British Association in 1937, another one has been made, by A. N. Duckham, with the authority derived from his position as a research officer in the Bacon Development Board. Political considerations were obviously outside his scope, so that the *pros* and *cons* of producer or State control, levy-subsidies or tariffs, Treasury grants or import restrictions, etc., are not discussed. He considers his subject under five heads: (i) Regulation and standardization of commercial practice; (ii) Statutory combination and control of competition; (iii) Price stabilisation; (iv) Distribution and "consumption steering"; (v) Promotion of demand for British farm products. He concludes that the State has said farewell to *laissez faire*, and that whether the present reorganisation can be permanent or not "most will agree that the world has sickened of the economic dynasty founded by Adam Smith, and that planning and State intervention in marketing have come to stay" (Ref. 41).

A publication which all farmers should read has been issued by the Canadian Department of Agriculture, under the title of "The British Market and the Canadian Farmer." Its main purpose is to show the immensity of the United Kingdom market, its chief peculiarities and the nature of the competition which producers for it have to meet. The regulations taken and recommended for the marketing of Canadian farm produce in the finest conditions are a revelation of the importance of agriculture and of the promotion of an export trade in its products, in Canadian national life. They are an eye-opener also to the home producer as to the sort of competition which he must expect (Ref. 42).

To turn from general principles to particular commodities, a local study, made in Somerset by B. L. Smith and H. Whitby, of the effect of milk marketing organisation on the disposal of

milk, showed some interesting results. Central Somerset is, of course, an exporting area, much of its production being surplus to the requirements of the liquid market. The results of the Milk Marketing Board's pooling arrangements have been to increase the net returns to the producer of wholesale milk by $\frac{1}{4}d.$ a gallon, a figure which is augmented by the various premiums received by some producers. But perhaps the most interesting result of the guaranteed market now available for liquid milk has been the decline in farmhouse cheese-making. Making farmhouse Cheddar cheese has been a traditional industry in Somerset, and more recently the manufacture of Caerphilly cheese has become important. In 1932 and 1933, about 1,000 tons of farmhouse Caerphilly cheese was sold at Highbridge each year, while the average of factory cheese was less than 300 tons. In 1935, the pitch of farmhouse cheese had dropped to 38 tons, while the factory product had risen to 1,400 tons. No one who can sell milk will make cheese (Ref. 43).

Egg marketing is a thorny question. Producers are not agreed upon what they want, and a good many of them fail to see the implications of their demands for higher prices, which could only reduce the demand for English eggs. During the year, a joint committee on marketing, of the National Farmers' Union and the National Poultry Council, was set up, to formulate principles of marketing reform which would receive the support of poultry keepers throughout the country. The Committee prepared a scheme under the enabling powers of the Marketing Acts. Their proposals are formulated in a report issued in September, 1937, by the National Farmers' Union, but no action has yet been taken upon it (Ref. 44).

2. *Prices and Supplies.*

The distributor's margin has been a matter of acute controversy ever since the publication of the Report of the Departmental Committee, over which the Marquis of Linlithgow presided, in 1924. In the recent depression, the excessive spread of prices, as it is claimed, has been repeatedly the subject of comment by the representatives of farmers and consumers alike. Information, of course, is obtained only with difficulty, and statistics of the costs of processing and distribution and all the overhead charges are both scanty and incomplete. The broccoli which realises $\frac{1}{2}d.$ for the grower and sells at $8d.$ in the shop is only one example of many which can be quoted where the spread seems to be excessive, while in large towns the redundancy of distributors of certain commodities seems often to need no proof. But proof is needed, and it is only by the most careful analysis of all the costs incurred that light can be thrown upon the problem. The International Institute of Agriculture at

Rome has rendered a service by bringing together into one report the results obtained in the investigation of price spreads in various European countries and in the United States. The information relating to Great Britain is derived mainly from the Report of the Linlithgow Committee and the Reports of the Food Council (Ref. 45).

Towards the end of 1937, the Food Council presented a report on the cost and profits of retail milk distribution. Briefly, it found that the distributors' margin gave a high rate of profit to the Co-operative Societies, but that in proprietary concerns the rate of profit differed very widely. It found, further, that costs of distribution were increased by the excessive number of distributors, leading to much overlapping and excessive competition. It found that, in the main, the margins had been fixed in the various areas without relation to services rendered, so that distributors giving a simple service are allowed margins which have been fixed by reference to the more elaborate service given by other distributors. The recommendations of the Committee as to possible action follow obviously on these findings (Ref. 46).

These conclusions of the Food Council are fortified by an investigation carried out by J. S. Cripps, to find out what are the problems involved in retail distribution, as an essential preliminary to their elucidation. The subject is an immense one, for the problem of the distribution of milk is the problem of retail distribution generally (Ref. 47).

The tendency of the milk marketing organisation has been to introduce more uniformity into retail milk prices. Cheap milk can no longer be obtained in the consumer's jug at the farmhouse door. At the same time, prices do vary between different areas, and an examination by R. L. Cohen of retail prices before and after the coming of the Milk Marketing Boards supports the criticism that the Boards have deprived consumers living in the areas where production is cheaper, of the chance of getting cheaper milk (Ref. 48).

Miscellaneous.

1. *Education in Rural Areas.*

It is a complaint against our public education system that the curricula of its schools are designed to fit children for life in towns rather than in the country. Agriculturists, indeed, have been known to say that it is education which has ruined the farm worker. This is nonsense, of course, and in the elementary schools all are agreed that only the foundations of a general education can be laid. In rural secondary schools, however, it is suggested that more could be done to preserve a better balanced outlook between town and country, and the case for

doing more to relate the problems of rural life to the work of the boys and girls was introduced recently for discussion to the members of the Farmers' Club by G. W. Olive. He himself has done more than most schoolmasters to show how rural studies can be truly educational, not merely vocational (Ref. 49).

2. *The Agricultural Research Council.*

Three publications descriptive of the constitution and work of the Agricultural Research Council may be quoted. This body is responsible for advising the Ministry of Agriculture upon all applications for grants for research work, and it can also initiate research and conduct investigations through its own officers. Two of these publications are the official reports of the Council (Refs. 50 and 51), and the third comprises a paper prepared by the first Secretary of the Council, Sir William Dampier, for the members of the Farmers' Club (Ref. 52).

3. *Research in Agricultural Economics.*

The close of the year 1937 marked the 25th anniversary of the beginning of organized research in the economics of farming through the establishment of the Agricultural Economics Research Institute, at Oxford. An account has been published describing the evolution of the work since 1913, with a complete list of the publications of the Institute, and of the names and records of those who have passed through it (Ref. 53).

4. *The Agricultural Register.*

This annual volume, recording agricultural legislation, organisation under the Marketing Acts, statistics of supplies and prices of agricultural products and requisites, and other matters of interest to farmers and the general public, has been re-arranged, so as to facilitate its use as a book of reference. Previously, the sections had been arranged under headings such as legislation, organisation, supply, prices, etc., so that to follow the experiences of the milk industry, for example, it was necessary to look up a good many references. This year, the contents have been arranged under commodities, so that the whole story of the dairying industry in 1937, to take milk again for an example, may be read consecutively (Ref. 54).

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DAIRY FARMING AND DAIRY WORK.

GENERAL NOTES.

The Milk Marketing Scheme. The fourth year of operation of this scheme ended in September, 1937, and the success which has attended this year's operations has made the position of the Scheme and the Board more stable. At the same time dairy farmers, and indeed, the whole milk industry, awaits with interest, and in some cases trepidation, the Government's proposals arising from the recommendations in the report of the "Cutforth" Reorganisation Commission, which were referred to in last year's review. The latest pronouncement is that the

Bill, which is the necessary sequel to the White Paper on Milk Policy issued in July, 1937, is to be postponed until the autumn of 1938.

The milk price contracts for the twelve months commencing October 1st, 1938, provided for a slight increase in price, namely 15/11 per dozen gallons compared with 15/3 for the preceding twelve months. The annual report and accounts of the Milk Marketing Board do not refer to the contract year but deal with the twelve months from the 1st April to 31st March. The report (Ref. 1) for the twelve months ending March 31st, 1938, contains much interesting information on the various activities of the Board.

The total quantity of milk handled by the Board during this period was, in round figures, the same as in the previous year—1,011 million gallons. The distribution of this total, however, showed considerable change. The quantity sold in the liquid milk market rose from fully 669 million gallons to fully 720 million gallons—an increase of over 51 million gallons, or 7·7 per cent. On the other hand, the quantity utilised for the manufacture of produce fell from about 343 million gallons to about 291 million gallons—a decrease of 52 million gallons or 15·2 per cent. This distribution, when stated in general percentages, shows that the liquid milk market absorbed 71·3 per cent. of the total and the manufacturing market 28·7 per cent., whereas the corresponding percentages for the last two years were 66·3 and 33·7. This increase in the quantity sold as liquid milk, together with the allocation by the Board of milk to the manufacture of those products which gave the best returns, slightly increased the average price received by the producers. The average declared pool prices, subject to deductions for transport charges, were 11.91*d.* per gallon in 1936-37 and 12.77*d.* per gallon in 1937-38. There was also an increase in the quantity of milk made into cheese on the farm; in the previous year some 18 million gallons were so used, and last year the quantity was fully 21 million gallons—an increase of about 16 per cent.

The increase just referred to in the quantity and proportion of milk taken by the liquid milk market indicates that the various efforts made by the Board to increase the consumption of liquid milk are proving effective. These efforts include advertisement; schemes for the supply of milk to factories, mines and offices, and for the provision of cheap milk in special areas; and advice in respect of milk bars and the Milk in Schools scheme. Under the latter scheme the quantity consumed increased by some three million gallons—a welcome change after the slight decrease noted last year.

It is, however, still desirable that the consumption of liquid milk should increase, and an interesting survey of the factors

affecting the consumption of milk has been carried out by Murray (Ref. 2) in Oxford. The author refers to other inquiries which have shown that the quantity of milk and other foods consumed rises as the income rises, and to the inference that income is the chief limiting factor in the greater consumption of milk. The survey covered 587 households taken at random in the city of Oxford, and, in addition to interesting information on other points, an analysis of the data showed wide variations in the amount of milk bought in households spending the same amount per head on food. This points to the conclusion that factors other than income are of material importance in limiting milk consumption. The author states that "the difficulties in the way of increasing the consumption of milk are partly lack of purchasing power and distaste, but possibly the biggest obstacles are antipathy, indifference and prejudice . . . Lack of demand, if due to lack of purchasing power, cannot be remedied by producers, but if it is also due, as this study indicates, to such factors as habit and lack of interest, then the remedy lies partly within the control of producers themselves. Undoubtedly these factors are difficult to overcome but it has been done for other commodities. Extensive advertisement may be a better investment than lower prices for a producers' organisation."

There is now no doubt that the operation of the Milk Marketing Scheme has been generally beneficial to the dairy industry in this country in spite of the adverse criticism arising mainly from producer-retailers, and occasionally from producers, in areas where practically all the milk was, and is, absorbed by the liquid market. Areas where a large proportion of the milk is used for manufacture of produce have benefited appreciably from the scheme, and an interesting report on its effects in part of Somerset has recently been published (Ref. 3.)

A survey of an area in Central Somerset mainly devoted to milk production had been carried out by the Agricultural Economics Research Institute, Oxford, in 1931-32, and in 1935-36 it was decided to repeat the work in order to obtain information on the changes which had taken place in the production, disposal and utilisation of milk in the area. The report is based on data collected from 1,460 farms at the two surveys. The area covered comprises 128,000 acres (of which only 3 per cent. is arable) and the average size of the farms is 88 acres.

The information collected showed that the total milk output had risen by 13·3 per cent., and that this increase was due almost entirely to an increase in the number of cows. It is pointed out that a steady increase in the cow population of the country as a whole had taken place for several years previous to the inauguration of the Milk Marketing Scheme in October,

1933, and that this movement continued, but at a diminishing rate, during the first three years of the Scheme. In Central Somerset, however, the increase in the number of cows from 1932 to 1935 was proportionately much greater than that for the country as a whole, namely 16·6 per cent. as compared with 6·0 per cent., and was not associated with any material change-over from beef production or the raising of store stock; it was due to an increase in the number of cows per farm, which rose from 20 to 23·3 (say 4 cows per 100 acres); the change was proportionately greater on the smaller farms. It is suggested that the chief reasons for this expansion were the prospect of an assured market for all milk, greater ease of marketing, and the desire to maintain income, in spite of rising pool deductions, by increasing the output of milk.

The disposal of the milk also showed marked changes. In 1931-32, nearly 31 per cent. of the milk sold wholesale went on the liquid market, compared with only 11·7 per cent. in 1934-35. Again there was an appreciable rise in the proportion of milk sold under wholesale contracts, due in part to a decrease in the manufacture of cheese on the farm. In June, 1932, cheese was made on 204 farms in the area (Caerphilly on 71 farms and Cheddar on 135 farms—two farms making both kinds); whereas in June, 1935, the number had fallen to 112 (Caerphilly on one farm and Cheddar on 111 farms). Cheddar cheese-making on farms has been maintained to some extent by the subsidy paid through the Board but the making of Caerphilly cheese has died out on farms and has become a factory industry.

By far the greater part of the milk produced in Central Somerset is sold to creameries or factories, and there has been a notable increase in the manufacture of butter and cheese; indeed there is, apparently, keen competition to buy milk, and this has led to reduction in the transport charges.

A comparison between the conditions in 1931-32 and 1934-35 indicates that the effect of the Milk Scheme has been favourable. Producer-wholesalers, producer-retailers and farm-house cheddar cheesemakers all showed returns, in 1934-35, which were greater than they could reasonably have expected if the industry had been allowed to continue in an unorganised condition.

Accredited Milk. The rate of increase in the production of this grade of milk has unfortunately been very slow during the last year. When the Accredited Scheme was inaugurated in May, 1935 there were some 800 producers holding licences for the corresponding grade of milk (the designation then in force being Grade A); by December, 1935, the number had risen, mainly through the benefits accruing from the Board's Scheme, to 13,655; in December, 1936, it was 20,080, but by December, 1937, the total was only 21,621. The figures show an increase

of some 12,855 in the eight months of 1935, 6,425 in 1936 and 1,541 in 1937 (Ref. 4).

The slowness of the increase shown by these figures is no doubt due, in some small measure, to a small proportion of "Accredited" producers having qualified for "Tuberculin Tested" licences; but there are approximately 150,000 producers in all, and these results show clearly that many thousands of dairy farmers hesitate to raise the level of their production to the "Accredited" standard. A study of the monthly price reports, however, shows that the amount of milk qualifying for the "Accredited" bonus of 1*d.* per gallon is some 37 per cent. of the whole, so that the owners of the larger herds apparently find the least difficulty in becoming "Accredited."

This partial failure of the Accredited scheme constitutes a problem for the Board and for the industry as a whole. The improvement of the hygienic standard of milk production can be brought about by three means—education, financial inducements and legislation—working independently or together. If education and the present financial inducements are insufficient to bring about the all-round improvement that is still necessary, then additional inducements, or legislation, or both, must be brought into action. The long-delayed bill to give effect to the statement of policy contained in the "White Paper" on Milk Policy (Ref. 5), which was issued in July, 1937, may indicate that additional measures are contemplated.

Tuberculin Tested Milk. Producers of "Tuberculin Tested" milk, according to the Milk (Special Designations) Order 1923 and 1936, were exempted from the Milk Marketing Scheme at its inauguration in October, 1933, but this exemption was withdrawn, as from 1st October, 1937, with the consent of the Ministers of Agriculture and Health. Producers of this grade of milk had been steadily increasing in numbers and it was evident that continued exemption might be prejudicial to the interests of producers as a whole. The Ministers concerned, however, in agreeing to the withdrawal of the exemption, made a number of reservations in favour of "Tuberculin Tested" producers; the chief of these were (1) that sales of this grade of milk bottled on the farm should be regarded as retail sales, (2) that a producer-retailer's contribution to the Board would not be more than $\frac{3}{4}d.$ per gallon (less $\frac{1}{4}d.$ per gallon for prompt payment), (3) that "tuberculin tested" milk sold wholesale through the scheme would earn a quality premium of not less than 1*d.* per gallon, in addition to any other quality premiums which might be earned, and (4) that the above-mentioned contribution and premium would be paid up to 30th September, 1939 and thereafter would be varied only on the certificate of the "consulted person."

The Minister of Agriculture also advised the Milk Marketing Board that the wholesale price of "Tuberculin Tested" milk should exceed that of ordinary milk by at least 2*d.* per gallon, and that the minimum appropriate retail price should also exceed that of ordinary milk by at least the same sum. Further, the Minister of Agriculture requested the Board to appoint an Advisory Committee, consisting of two representatives of the Board and two representatives appointed by the Tuberculin Tested Milk Producers Association with an independent Chairman, to advise the Board as to price and other matters affecting "Tuberculin-Tested" milk. It is interesting to note that the number of licences issued for the sale of this grade of milk continues to increase. In March, 1937, there were 1,670, and by March, 1938, 2,492.

The Tuberculosis (Attested Herds) Scheme. It is now possible to record marked progress in the adoption of this scheme by herd owners. This welcome change has been brought about mainly by two factors—firstly by the changes made in the scheme, as from June 1st, 1937, whereby financial assistance for tuberculin testing was given to owners who had already reduced the number of reactors in their herds to under 10 per cent., and secondly, to the inclusion of "Tuberculin Tested" milk in the Milk Marketing Scheme in England and Wales from October 1st, 1937. A considerable proportion of the producers of this grade had no difficulty in qualifying for Attestation, and proceeded as soon as inclusion in the scheme made it worth while to gain the bonus of 1*d.* per gallon paid on all milk from Attested herds sold through the Board.

A concise statement showing the rate of progress, and the numbers and distribution of the herds which had become Attested at various dates, is given below. The details up to 31st December, 1937, are taken from the five Registers of Attested Herds issued on the dates mentioned (Ref. 6) and the figures for England and Wales on 31st March, 1938, are taken from the Annual Report of the Milk Marketing Board for England and Wales (Ref. 1).

Number of Attested Herds to March 1938.

Date of issue of Register.	England.			Wales.			Scotland.		
	No. of Herds.	No. of Animals.	Aver. per head.	No. of Herds.	No. of Animals.	Aver. per head.	No. of Herds.	No. of Animals.	Aver. per head.
31 August, 1935	24	1,092	46	7	176	25	27	2,267	84
31 March, 1936	49	2,243	46	32	1,041	33	88	6,922	79
31 July, 1936	68	3,245	48	49	1,585	32	144	11,826	82
31 Jan., 1937	88	4,232	48	120	3,712	31	256	21,025	82
31 Dec., 1937	416	25,138	60	396	11,758	30	640	50,433	79
31 March, 1938	603	37,044	61	587	16,595	28	—	—	—

The increase in the number of Attested Herds in England is remarkable and it is interesting to note that it is associated with a definite rise in the average size of herd; geographically, the south-east of England has the largest number of Attested herds but no one county has markedly outstripped the others. In Wales the average size of herd shows no increase. A very large proportion of the Attested Herds are found in the south-west, the county of Carmarthen alone having about 300. In Scotland most progress has been attained in Ayrshire (where there are over 300 Attested Herds) and the high average size of the herds has been maintained. When considering the size of herd it is important to remember that the numbers given include stock of all ages, and, since the number of young stock is approximately 50 per cent. of the total, the numbers of cows and heifers, in milk and dry, may be taken as half the numbers given above.

Further amendments of the Scheme came into operation on July 1st, 1938 (Ref. 7). The chief of these is the extension of the Scheme to any type of herd which is maintained in such a manner as to render possible the observance of the rules. This opens the scheme to beef or rearing herds. As such herds do not necessarily sell milk, owners of Attested herds will in future have the choice of payment of bonus either (1) at the rate of 1*d.* per gallon for milk sold under a Milk Marketing Scheme or made into cheese on the farm or (2) at the rate of 10/- per head at half-yearly intervals on the cattle in the herd, subject to a maximum of six half-yearly payments.

The Eleventh World's Dairy Congress. To many, the triennial World's Dairy Congresses, sponsored by the International Dairy Federation, are events of major importance. National and International conferences and congresses on various aspects of agriculture and its related sciences are now much more common than formerly, and the keeping in touch with their findings imposes an additional burden on research workers and advisors; nevertheless it is beyond question that such meetings afford valuable opportunities for learning something of the research work and practice in other countries, and for an exchange of views between workers in the same subject.

The practice and science of dairying is now of such importance in the national economy of many countries that a well organised international congress cannot fail to be of almost universal interest, and the Eleventh World's Congress held at Berlin in August, 1937, surpassed in magnitude all previous meetings. Representatives were present from 52 countries and the membership of the Congress totalled 3,638, made up of 1,463 Germans and 2,175 foreigners. The number of representatives from Great Britain was 224—a total which was exceeded by only

three other countries. The number of papers and reports submitted to the Congress was 413 from 31 countries; Great Britain again occupied fourth place, with 22 contributions.

These figures give some idea of the scale of the Congress. The arrangements for the sectional meetings, summaries of the papers according to subjects in three languages (German, English and French), facilities for interpretation and educational and social activities attained a very high standard and supplied many object lessons of German skill in organisation.

It will be readily understood that many of the reports presented and the discussions thereon were of interest mainly to the representatives of continental countries. Other reports, however, such as those dealing with the use of milk records in breeding and feeding, the feeding of dairy cattle on home-grown produce, the control of contagious abortion and tuberculosis, the improvement of the quality of milk and milk products, and the nutritive value of milk, contained information of interest to British dairy farmers and, wherever this information comes within the scope of this review, it will be referred to in the following pages. A descriptive report on the Congress is given in the Journal of the British Dairy Farmers Association for 1938 (Ref. 8) and all the papers, summaries, etc., have been published in four volumes by the German Ministry for Nutrition and Agriculture (Ref. 9).

American Dairy Husbandry. Dairy farmers are occasionally told that, in many aspects of milk production and dairy herd improvement, they have much to learn from American practice. It is, therefore, specially interesting to have a report of a first-hand study of American methods by one who is thoroughly familiar with English conditions. This report is published by the College of Estate Management (Ref. 10) and was written by Foot who, in 1935-36, was granted a college travelling scholarship for one year to study in the United States and Canada those aspects of dairy husbandry which are important, or are becoming important, to dairy farmers in Great Britain.

It is not possible here to do more than refer to the main subjects dealt with. A description is given of the dairy farming conditions and the chief problems of several areas devoted to milk production for liquid consumption and for manufacture; then attention is devoted to the improvement of dairy stock; special reference is made to the accuracy of American methods of milk recording and to the numerous studies which have been made on body conformation in relation to milk yield; the control of the hygienic quality and also the fat content of milk is discussed, together with methods of standardisation of market milk and the efforts to produce commercially milk of high vitamin A and D content. The writer stresses the advantages

to be gained by English research workers in Agriculture and Dairying by visits to the numerous and well equipped American research stations and by personal contact and exchange of views with the staffs of these institutions. This volume is worthy of a place in all libraries dealing with dairy husbandry.

Dairy Cattle—Breeding, Type and Management.

Progeny Recording. The collection and utilisation of progeny records of dairy bulls through the County Milk Recording Societies should receive a much-needed stimulus by the issue from the Ministry of Agriculture of a revised progeny recording scheme (Ref. 11). The scheme, and the record sheet which is issued with it, are designed to provide, in the simplest manner, a record of the milk yield and fat percentage of the daughters of a bull for each lactation period up to four; if desired, and if the information is available, the corresponding records of each daughter's dam can also be entered. Particulars of the scheme and the record forms can be obtained through any Milk Recording Society, and the recorders will advise and assist in making and checking the entries from the annual register of the herd.

The need for the use of properly stated progeny records, and indeed, milk records also, in sale catalogues of dairy stock is strongly emphasised by Hunter Smith (Ref. 12) who points out the difficulty of maintaining a dairy herd solely by home-bred stock when, in addition to the disposals necessitated by the pursuit of a progressive health policy, a considerable number of home-bred heifers fail to attain a satisfactory level of milk production. Experience in numerous herds has shown that efforts to free a herd from tuberculosis, contagious abortion and other diseases, curtail the owner's freedom to cull vigorously, and thus tend to lower the average milk yield; it is therefore opportune to press the point of view that an enlightened breeding policy, making full use, in the right way, of all available information, is an essential corollary to a disease-eradication policy.

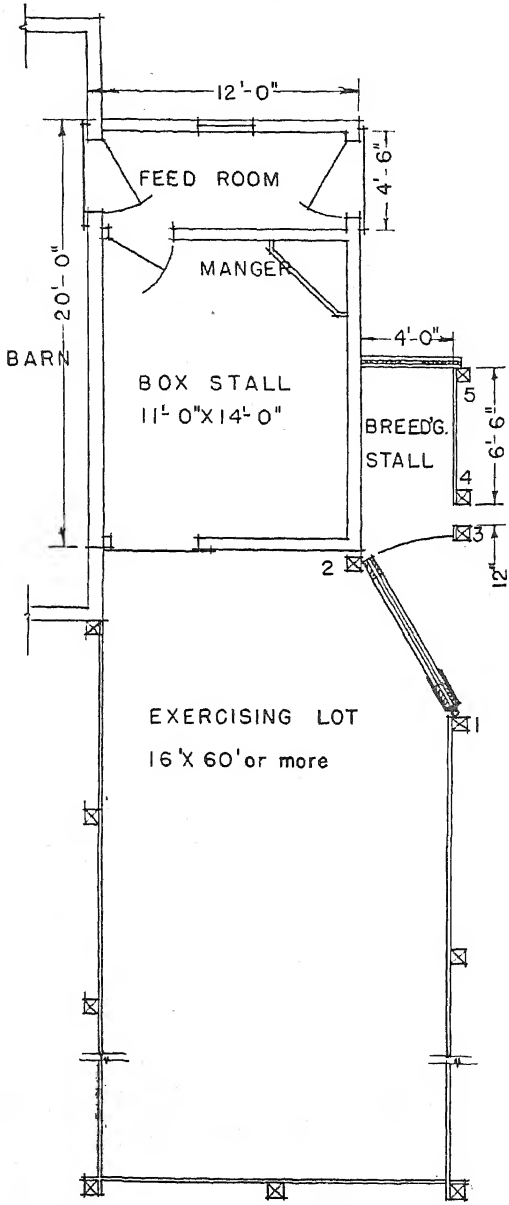
Buchanan Smith and Robinson draw attention to the variations in the milk yields of the daughters of 76 different bulls (Ref. 13) as found in three Dairy Shorthorn herds in England. The conditions of management, though not identical, were generally similar. The milk yields of the daughters were age-corrected and all abnormal lactations were discarded. Each bull had six or more daughters. In a large proportion of the progeny groups great variation was found amongst the individual daughters, and this variation was independent of the general level of milk yield. For example, in one herd, a particular bull had ten daughters which averaged 830 gallons, with a range from 491 to 1,420 gallons; another bull had 9 daughters averaging 893 gallons with a range of from 610 to 949 gallons. The writers

state that "from the point of view of the improvement of dairy cattle it is obvious that what is required is a bull whose daughters have a high average yield with small variation amongst their yields. Apparently this type of bull does exist." The importance of this aspect of progeny-test work is stressed if substantial progress is to be made by the use of proved bulls.

An important practical point concerned with progeny recording is the management of aged bulls. Greater attention is being given to the housing of bulls, provision being made for fresh air and exercise; also, in order to lessen the need for catching and leading the bull, breeding racks can be erected in a convenient corner or end of the yard. McCandlish and Struthers have published (Ref. 14) details of one type of bull pen, with dimensions and illustrations, and a more elaborate description, with particulars of the materials used for the shed, fencing and breeding rack, is given by Rhode and Foster (Ref. 15). Special emphasis is laid on the advantage of a long narrow yard, (say, 16-18 feet wide and 60-70 feet long, with a shed at one end, say 11 feet by 14 feet) for inducing a bull to take sufficient exercise. Where two bulls are kept the cost of erection will be lessened by placing two yards side by side. A plan of this type of single bull pen is given on page 260.

Sex-Linkage in Milk Inheritance. In another publication (Ref. 16) Buchanan Smith returns to the problem of sex-linkage in the inheritance of milk production. The information available five years ago, on this important matter, was summarised in the 1932 issue of this review (Ref. 17) and in the interval no definite evidence for or against the theory has been brought forward. It may be desirable to explain that the inheritance of milk-yielding qualities in a sex-linked manner would mean that a bull's powers in this respect would be transmitted to his daughters but not to his sons. If this were proved beyond doubt, a basic fact of great importance in the breeding of dairy stock would have been established.

In his recent paper Buchanan Smith reports the results of a comprehensive study of the breeding and recorded milk yields of three large Dairy Shorthorn herds, using new statistical methods which meet criticism directed to previous work. He finds evidence of the fact that the paternal grandsire has less influence than has the maternal grandsire, on the yields of his grand-daughters, and no evidence to the contrary. He points out the practical implication, namely that, in the selection of a herd bull for a herd, undue emphasis should not be placed on his sire. It is indeed an advantage that the latter should be a proved good sire, since in this case he is bound to have some of the desired genes or units of inheritance; but as regards the desired sex-linked gene, this can be obtained by the bull only



FLOOR PLAN OF A BULL SHED, EXERCISING YARD AND BREEDING STALL.

from his dam, and therefore the yield of the dam of the bull is of prime importance. Another implication affects our views about inbreeding. If sex-linkage is important, then inbreeding for high milk production, by the concentration of the blood of a famous sire through his sons, cannot be effective. It is further pointed out that inbreeding has not, in fact, been successfully employed as a means for the creation or improvement of dairy breeds, although it has been of the greatest use to the breeders of beef cattle. In summing up the present position of the problem Buchanan Smith expresses the opinion that statistical studies of results obtained in different herds, while providing additional information, cannot give a definite answer; carefully planned experiments are essential to the solution of the problem. His studies have shown that an unexplained factor in milk inheritance exists. If this unexplained factor is not genetic or sex-linked, but is due to the conditions of growth or management, it requires to be discovered, since it most certainly influences the choice of methods of selection by the breeder of dairy cattle.

In another sentence Buchanan Smith raises the question as to the mode of operation of a gene that affects the yield of milk, and indicates that the assistance of the physiologist is necessary. In this connection the work of Turner and others in the United States (Ref. 18) and of Folley in England (Ref. 19) is of great interest. Turner, in reviewing available information on the hormones secreted by the pituitary and other ductless glands, makes the interesting speculation that the discovery of the hormonal deficiencies of dairy cattle will lead to new methods of studying the inheritance of milk production. He believes that, in the course of time, it should be possible to identify all the factors that combine to enable the high-producing cow to transform large quantities of nutrients into milk, and to discover what particular deficiencies, in glands or hormones, limit the production of low producers. He also hints that, through the discovery of the chief deficiencies and excellencies of different families of dairy cattle, it should be possible to adopt a system of compensative matings and to build up character combinations which would result in the production of milk at levels far above present standards.

Continental Points of View. It is interesting, and helpful in maintaining a balanced perspective, to turn from Turner's speculations to the views of continental workers as set out in papers submitted to the World's Dairy Congress. In the section devoted to milk production special attention was devoted to the use of milk records in relation to breeding. Several contributors laid special emphasis on the importance of selecting for breeding purposes, and particularly as dams of stock bulls, those cows

which had a long healthy productive life. Battha (Hungary) (Ref. 20) maintains that "life efficiency" must receive greater recognition from breeders in general, and points out that young cows suffer most through attempts to obtain record yields. Schaper (Germany) (Ref. 21) approves of the increase in yields which has followed the use of milk records, and discusses the commonly held opinion that high yields are a danger to the health of dairy stock. He claims that a study of genetics, and of practical results, shows that constitutional diseases cannot be regarded as a result of high milk yields, for they can occur just as frequently with medium or low yields. Engeler (Switzerland) (Ref. 22) explains that Swiss breeders regard other qualities, such as constitution, health, fecundity, fattening powers, and working capacity as of equal importance with milk production. He states that, in Switzerland, constitution is not regarded as a measurable quality but as one that must be estimated by outward appearance; health is judged partly by bodily appearance and partly by clinical and bacteriological examinations; fecundity is recorded by having *all* births entered in the herd-book and by awarding "fecundity marks" to all cows which have had at least six normal births in eight years; performance up to this standard is regarded as the best proof of a good constitution and satisfactory health; fattening and working capacity are judged mainly by external appearance, but records of the yield and quality of meat from slaughtered animals afford additional data on fattening qualities; milk-yielding capacity is measured for herdbook cows which receive normal home-produced food and are managed under normal conditions. Another regulation mentioned by Engeler illustrates the strong contrast between our conditions and those obtaining in Switzerland; the use of purchased foods and foreign concentrates is forbidden (because these are not economic) in the mountainous breeding districts. It is apparent that existing economic conditions on the Continent are compelling a reduction in the importation of cattle foods. Both State policy and financial stress are compelling herd owners to rely more and more on the produce of their own farms for the feeding of their stock, and therefore to select for breeding purposes those cows which maintain good production, over a period of years, under these conditions.

Artificial Insemination. During recent years the application of artificial insemination in the mating of farm live stock has received much attention in stock-breeding countries. In Russia particularly, new technique and apparatus have been devised for the collection, storage, transportation, dilution and use of semen in the artificial insemination of mares, cows and ewes. Artificial insemination is now practised on a large scale, and at

considerable distances from the home of the sire. In England, much work has been done by Hammond and Walton of Cambridge, and their lectures and writings have done much to bring the newer knowledge on this subject to the notice of farmers (Ref. 23, 24). Miller also discusses the subject in some detail (Ref. 25) and points out that in this country there is no dearth of good sires and that the quality of stock throughout the country is high; by contrast there are other countries such as Russia where the pre-War stock, never of high quality, had greatly degenerated in type and diminished in numbers, so that special efforts were required to bring about improvement. Valuable sires were therefore imported, but their effect, used only by natural mating, would have been only slight in such an immense country. By the new methods it has become possible to make much fuller use of the imported males. Walton states that many millions of satisfactory progeny have now been produced.

Apart from the much fuller use which can be made of selected and proved good sires, numerous other advantages are claimed for the new method. The chief of these, particularly with regard to cattle, are that the danger of the bull's transmitting diseases from cow to cow is practically eliminated; that the difficulty of mating heifers to a fully grown bull is overcome; that the use of a fertile bull can easily be ensured; that, by suitable arrangements for the collection, transport, etc. of semen, the breeding value of a proved bull can be spread over a wide area and many farms; and that the trouble and cost of keeping a bull for each small herd can be avoided. Walton states that a bull produces enough semen at each service to inseminate 20 cows, provided the proper methods of dilution are used, and also that artificial insemination overcomes certain forms of sterility.

The work done in England has been mainly of an experimental nature. Bartlett reports (Ref. 26) the results obtained in the herd of the National Institute for Research in Dairying. Here the methods described by Walton were adopted partly in order to gain experience with the procedure and partly in an effort to reduce the risk of spreading contagious abortion. Out of a total of 57 services by artificial insemination, 18 (or 32 per cent.) proved effective, while out of 253 normal matings, 98 (or 38 per cent.) proved effective. These are low fertility figures, which are partially accounted for by the presence of contagious abortion in the herd. Bartlett adds that no insurmountable technical difficulties were encountered and that no ill effects were observed on the health of the cows or the progeny.

Another writer gives an account of a trial of the method, on a much larger scale, in Denmark (Ref. 27). On an island in the Baltic the members of the local Bull Association agreed to have

a proportion of their cows artificially inseminated from two carefully chosen bulls. The Association employed a young veterinary surgeon to give his whole time to the project. It is reported that 1,200 cows were artificially inseminated during the first year and that the average number of services per conception was 1·3. A previous study of many herds in the Association had shown that, with normal mating, the average number was 1·8. For purposes of comparison it is interesting to recall a report reviewed in 1931 (Ref. 28); in an American herd where abortion had been prevalent, the average number of natural services per conception over 29 years was 2·52, while in seven other well managed herds the average was 1·9, with a range from 2·25 to 1·6.

From the point of view of the breeder of pedigree stock, the possibility of obtaining progeny without direct service raises the question of ensuring that the ancestry of stock is beyond suspicion. At least two breed Societies in England have considered this matter (Ref. 29, 30) and have adopted regulations governing the entry into their respective herd-books of calves born as the result of artificial insemination. These regulations require that the approval of the Breed Society shall have been obtained by the owner of the cow prior to the insemination, and specify the certificates which are essential to establish the identity of the bull from which the semen was obtained and of the cow or cows which were inseminated.

Milk Recording.

Revision of the Official Scheme. The present official Scheme of milk recording in England and Wales was introduced in 1913 but, for obvious reasons, no great progress was made until 1919. For the next ten years substantial progress, though at a descending rate, was made. Then came a period of little or no progress ending in a widespread conviction that the scheme required modification in many respects. Indeed, after a period of fully 20 years during which there had been but minor alterations, it seemed eminently reasonable that the scheme should be completely overhauled. In 1936 an informal committee, representing the Ministry of Agriculture and the Central Council of Milk Recording Societies undertook an enquiry into the working of the official Scheme, and a report was issued in April, 1937 (Ref. 31).

This report does not recommend any major or essential changes. The possibility of an alternative scheme—on the lines of that in force in Scotland and in several continental countries—was carefully considered and the comparative advantages were tabulated. In favour of the English scheme it is stated firstly, that it is of greater educational value;

secondly, because the members of the Societies themselves weigh the milk of each cow, either daily or weekly, the results are more accurate, and members have a more intimate knowledge of the conditions in their herds; thirdly, by reason of its greater accuracy, this system is better for breeders of high-class pedigree stock. Fourthly, it has the advantage that the periodical visits of recorders are "surprise" visits, and that the provision of meals and lodging for recorders is barred.

The main advantage of the "Continental" system are that the overhead expenses are far less, with the result of lower cost to members, and that all the clerical work is done by the recorder. Additional advantages are that butter-fat samples are taken every 3-4 weeks, instead of 8 times yearly as under the English system, that the quality of the recorders' work is higher than that of English members and that the recorders create a more uniform standard of recording and thereby eliminate member's idiosyncrasies. The Committee came to the conclusion that it could not recommend a scheme based on the "Continental" system as an alternative to that now operating.

A number of detailed recommendations were made with the object of lessening and simplifying the clerical work which must be undertaken by the member; another recommendation, to give greater prominence to lactation-period yields, should facilitate the use of records for age comparisons and in breed society publications. The subject of butter-fat testing was considered, and it was recommended that permission be given to test a composite sample of the milk of a cow for a twenty-four hour period, as an economical alternative to the testing of samples from each cow at each milking; further, it was unanimously recommended that the Ministry should examine alternatives, such as those used on the Continent, to the Gerber system of testing now employed in England. In view of the need for a great increase in the testing of the milks of individual cows, the results of a study of this question are anxiously awaited.

The committee also considered proposals for an unofficial scheme which should run side by side with the Ministry's official one, but decided that no plan for such a scheme should be submitted to the Ministry until the question had received further consideration by the Central Council of Milk Recording Societies. Up to the present this Council has not been in favour of any unofficial scheme.

The report issued by the Ministry of Agriculture on the milk-recording section of the Live Stock Improvement Scheme (Ref. 32) shows that both the membership of societies and the number of recorded herds has increased slightly during the last three years. One interesting feature, which is illustrated in the

table showing the details for each year, is the gradual increase in the size of the average recorded herd; in 1920-21, the average was 26·7 cows, in 1925-26, it was 27·3; in 1930-31, 28·5 and in 1935-36 35·9. The average annual yield of full-year cows (*i.e.* of those kept in the same herd for the full year) also continues to increase; in 1918-19 the average was only 579 gallons for nearly 18,000 cows, whereas in 1935-36 it was 741 gallons for nearly 79,000 cows. This increase of 162 gallons per annum, with a much increased number of cows, is a most creditable achievement.

The number of cows for which the average fat percentage is determined also increases steadily if slowly. The figures obtained for each breed constitute an authoritative standard of reference and are given below for each of the three years during which the individual averages have been ascertained:—

Results of Butter Fat Tests under the Ministry's Scheme, according to Breeds.

Breed.	1933–34.		1934–35.		1935–36.	
	No. of cows.	Aver. Fat Percent.	No. of cows.	Aver. Fat Percent.	No. of cows.	Aver. Fat Percent.
Ayrshire	673	3·77	906	3·71	1,133	3·78
British Friesian ..	2,496	3·31	2,908	3·26	3,153	3·26
Guernsey	2,396	4·64	2,639	4·63	2,821	4·61
Jersey	1,053	4·99	1,296	4·86	1,687	5·01
Lincoln Red	187	3·56	176	3·54	174	3·62
Red Poll	485	3·71	650	3·65	694	3·62
Shorthorn	2,486	3·61	2,822	3·56	2,744	3·58
Other Breeds	183	3·95	186	3·97	191	3·92
	9,959		11,583		12,597	

At the Eleventh World's Dairy Congress papers were submitted dealing with the methods of milk recording practised in numerous countries. The need for the more general adoption of milk recording was frequently stressed, and there was a general agreement that the milk produced by all animals in the herd should be weighed and tested for butter fat. Several contributors seemed convinced that much could be done by State action, and the Congress ultimately passed a resolution to the effect that "the interval between milk-yield tests should be subject to international agreement and should not exceed 28 days. The test should be regarded as supplying information for the half interval preceding and the half interval following the test" and "to obtain full advantage from the milk-yield tests in the improvement in the breeding of dairy cattle, the results should be in a standardised form" (Ref. 33). These

resolutions seem to express only hopes for the distant future, and there are matters of greater importance on which international agreement is more urgent. Further, agreement on a standardised form for stating milk yields may not be generally advantageous in view of the varying conditions in different countries. As far as concerns Britain, it would first be necessary that our own breed societies should agree on a uniform method of stating records and such agreement has not yet been reached.

In Germany, however, milk recording has been taken up very seriously. On November 22nd, 1935, the Government passed on decree that all owners of cows should be compelled to register and control (*i.e.*, record) the milk yield of their animals. Immediate compliance with this decree was neither possible nor expected, yet it is claimed that, by the end of 1936, 36 per cent. of the total German cow stock (some 10 million head) were controlled (*i.e.*, milk recorded) through the local associations; when 70 per cent. are controlled and the yields have been tabulated, facts regarding milk production will be available as a guide to management in small and large herds alike (Ref. 34). The problems of widespread development in Germany are, however, materially different from those in Britain, for the average herd in Germany contains only four or five cows.

Secretion of Milk and Milking.

Udder and Teat Structure. All dairy farmers are familiar with the question "to what extent does the loss of a quarter lessen the milk yield?" No definite and generally applicable answer can be given, but information gained by Swett and his fellow workers explains to some extent what happens inside the udder (Ref. 35). A Jersey heifer, 2½ years old, calved her first calf and came into milk with the left hind quarter entirely inactive and the right hind quarter yielding only a little fluid; normal milk was never obtained form either hind quarter, and both were described as "blind" almost from the commencement of lactation. The heifer's milk yield in this first lactation was 7,223 lb. milk in 365 days, with a maximum daily yield of 26 to 27 lb. She calved her second calf when 3¾ years old and produced 677 lb. milk in 20 days before the onset of septicaemia which caused her death. The udder was then removed and carefully examined, when it was found that the tissues of the front quarters had pushed backward and displaced a large part of the space normally occupied by the hind quarters. In view of the record made by this heifer in her first lactation, and of the relative development of the fore and hind quarters as shown by post-mortem examination, it is a reasonable assumption that the fore quarters became more active than they would otherwise have been, and at least partly compensated for the

loss of the hind quarters. A study of the quantity of milk yielded by each of the four quarters, in a large number of cows, has shown that the fore quarters normally produce but little more than 40 per cent. of the total yield, but it cannot be assumed that the Jersey heifer in question would, if all her quarters had functioned normally, have given more than twice her actual yield of 7,223 lb. When the loss of a quarter occurs early in life there can be little doubt that considerable compensation occurs by a marked development of the secretory tissue in the other quarters.

An anatomical study of teats carried out by Johnston (Ref. 36), though primarily of veterinary significance, supplies information of value to the cow owner and the milker. Some 324 teats from all types and breeds of cattle were examined. Inside each teat there is a cavity or sinus which connects above with a milk cistern or sinus situated in the udder above it, and which opens below through a duct or small channel; around the duct there is a sphincter muscle which to some extent controls the size of the opening. The inside of the teat sinus has a membraneous lining which in some cases is smooth and regular but which in others forms a number of small folds and pockets. Experiments were carried out which showed that the pockets and other irregularities in the lining membrane of the teat sinus might act as reservoirs for bacteria. It was also discovered that, when the udder is overstocked and the teat sphincter is subjected to considerable strain, a thin column of milk will be constantly flowing up and down the duct, with additional and intermittent pressure from the legs when the cow moves; thus, if the end of the teat is contaminated with bacteria, these will be drawn up into the sinus. Further, it seems probable that if, during milking, the upper end of the teat is not closed before applying pressure, bacteria in the teat will be driven up into the milk sinus in the udder. It is suggested that mastitis may in some cases be prevented, or its effects reduced, if this back flow is prevented, especially when drawing off the foremilk. These conclusions have a direct bearing on the management of cows with well filled udders, and on the methods of teat manipulation during milking; they point to the need for gentle treatment and cleanliness, and also to the harmfulness of overstocking.

Mechanical Milking. In the machine milking of cows the importance of thorough stripping is always stressed. It is interesting in this connection to note the results of some lengthy tests of the effects of complete and incomplete milking upon milk production and udder troubles. This work has been carried out in the United States by Woodward and his colleagues (Ref. 37).

Thirty-three lactation records, made by 14 cows, are reported. Each cow had at least one full lactation when she was milked completely, and at least one other lactation when she was incompletely milked. The cows milked incompletely were, for some time, milked thoroughly on one day each week in order to provide a basis for estimating the quantity of milk left in the udder on the other days. In the early part of the experiment complete milking was accomplished by hand stripping after the teat cups had been removed. Hand stripping was soon discontinued, however, and complete milking was accomplished by hand manipulation of the udder while the teat cups were still in place. The milk so obtained passed into the glass container of the milking machine. Observations had shown that the last milk was as completely removed by such manipulation as by stripping. The particular form of manipulation consisted of pulling downwards on the teat cups while gently squeezing the lower part of the udder. Care was taken to avoid squeezing the udder so hard as to cause bruises. Weekly samples of milk were taken from each cow for laboratory examination.

It was found that with the incomplete milking the quantity left in the udder varied in the different cows from 0·8 to 2·1 lb. at a milking, the average being 1·2 lb. With incomplete milking the average cow gave 306 lb. less milk in a full lactation than when she was thoroughly milked. Incomplete milking had no apparent effect on the average butter content for the entire lactation period, nor did it hasten the decline in milk flow, nor affect adversely the hygienic condition of the milk.

The authors conclude that since the leaving of a pound or two of milk in the udder at each milking has no affect on the percentage of fat (for the lactation period), the normality of the milk, the persistency of lactation, or the health of the cow, the only relevant considerations, in deciding whether or not to hand-strip, are the value of the milk obtained by the stripping, the cost of the work and the sanitation of the product. Manipulation, as practised, required an average of 39 seconds per cow per milking and yielded a net return of 0·64 lb. milk, or at the rate of 59 lb. per hour. The value of 5½ gallons of milk will usually be much greater than the cost of an hour's labour, hence the manipulation pays. The inference is also drawn that the milker, whether he works by machine or by hand, should not leave much milk in the udder, but should not spend much time in trying to get the "last drop" of milk. In this country, it must be remembered, there is often a risk that morning milk—even the mixed milk of a herd—may fall below the presumptive standard of 3 per cent. of fat, and that complete milking will lessen this risk.

Interesting information on the average capital costs and running costs of milking machines are supplied by Dawe (Ref 38). The average capital cost per cow for 33 farms, with herds averaging 48 cows, giving 731 gallons per cow per annum, was £4 4*s*. 2*d*. Direct running costs (power, repairs, overhauls and renewals) were 12/2 per cow and the depreciation, at 10 per cent. per annum, was 8/5 per cow. The figures per gallon were respectively 1·38*d*.; 0·20*d*.; and 0·14*d*. In other words the actual running costs amounted to one-fifth of a penny per gallon, and the all-in cost, with depreciation included, was one-third of a penny per gallon.

Use of Milkers' Ointments. In the milking of cows by hand it is not uncommon for the milker to use an ointment to lubricate his hands and the cow's teats, the object being to facilitate the manipulation of the teats. The once common practice of "wet" milking is now universally condemned as a dirty habit and the experiments carried out by Boyes and McClement (Ref. 39) showed conclusively that "dry" milking produced milk of much lower bacterial content than either "wet" milking or milking with the aid of vaseline as a lubricant.

The use of ointments has been studied in Germany by Seeleman (Ref. 40) with special reference to their value as disinfectants and in preventing the carriage of bacterial infection from cow to cow on the milkers' hands. Apparently it is sometimes claimed that certain ointments kill the streptococci and such other bacteria as may cause mastitis and other udder troubles. Seeleman reports that, with one exception, none of the preparations tested showed any rapid destructive action; with this one exception, the materials, when submitted to practical test in three large herds, produced no significant difference in the incidence of mastitis as between the treated cows and the untreated controls. Another investigator (Ref. 41) reports that some ointments have no disinfectant action and, indeed, act as sources of infection. This happens because the ointment becomes infected when the milkers put their milk-soiled hands into the ointment pot. Still another (Ref. 42) states that the value of such ointments cannot be assessed in laboratory tests; they must be tested under practical conditions —spread in a thin layer on the teats of cows and exposed to influences likely to destroy or reduce their disinfectant properties. These views and conclusions strengthen the recommendations in most of our English publications on hand milking and clean milk production, that, with proper management, milker's ointments are undesirable and unnecessary. Every milker should wash his hands before milking each successive cow, and any cows with infected udders should be milked last.

The Management of Milk and Milk Utensils.

The Handling of Milk and Milk Products. The heading of this paragraph is the title of the latest edition, revised by Mattick, of a bulletin issued by the Ministry of Agriculture (Ref. 43). Previous editions bore the title "Studies concerning the handling of milk," and both old and new editions differ from most of the Ministry's bulletins in that they deal almost exclusively with work carried out at the National Institute for Research in Dairying.

The new bulletin contains nearly 100 pages and constitutes a valuable work of reference for the milk producer, milk distributor, the manufacturer of dairy produce, and the adviser on dairy subjects. The dairy farmer will find in it the results of numerous experiments bearing on the production of clean milk, including the steam sterilisation of milk utensils; there are also useful notes on bovine tuberculosis. The wholesaler and retailer will find valuable information on the bacteriological aspects of pasteurisation, the phosphatase test, and problems of bottle washing and the use of bottle-washing plants. The cheese-maker will note that many faults, both in milk and in cheese, have been studied and their remedies found, and that attention is being given to the many and varied problems of cheese ripening. The student of nutrition will learn about the seasonal variation in the vitamin content of milk; about the effect of commercial pasteurisation on the availability of the milk minerals; and about the biological value of the proteins, the vitamin content and the total nutritive value of the milk. In view of the controversy which still rages around the effect of pasteurisation on milk, it is interesting to quote the following sentence: "When the results of the several laboratory experiments just described are considered it may be said, that, on the whole, they have failed to disclose any drastic loss in the value of milk as a food which could be attributed to commercial pasteurisation."

The condition of churns sent out by milk buyers to farms for the conveyance of milk has been studied by Provan (Ref. 44). His conclusions, based on the examination of some 230 churns returned to farms in the West Midlands, are as follows:—(*a*) Churns are often returned in an unsatisfactory condition and may be the source of large numbers of bacteria, including *Bacillus coli*; (*b*) contamination is greater in summer than in winter; (*c*) mechanical cleaning is usually superior to hand cleaning; (*d*) clean, dry churns are not as likely to cause contamination as clean wet or obviously dirty ones; but all churns should be sterilised after their return to the farm as their appearance cannot be relied on in deciding whether or not sterilisation is necessary.

Provan also comments on the need for clearing up the question as to who is responsible for the sterilisation of churns. At present, cleaning—and presumably sterilisation—are the legal responsibility of the distributor, but it is in the farmers' own interest, especially when he is producing graded milk, to safeguard himself by sterilising the churns after their return to the farm. This, however, should not absolve the buyer from his obligations; he ought to return thoroughly cleaned, steamed churns to the farm, and the law should be enforced more rigidly.

The development of the sale of milk in bottles has brought with it the problem of effectively washing very large numbers daily, and for this purpose a wide variety of bottle washing machines, large and small, are used. The problems which arise in bottle washing, and in the construction and use of bottle-washers, have been studied by Mattick and Hoy (Ref. 45). Faults in design are described with suggestions for improvement. The chief of these faults are: (*a*) contamination, with sour milk and dirty drainage water, of the water used for rinsing the washed bottles; (*b*) blockage of jets, which may be caused by material from bottle discs, or by hard water; (*c*) inaccurate index thermometers; and (*d*) contamination of washed bottles during transference from the washer to the filler. It is pointed out that contamination of washed bottles by recirculated rinsing water can be prevented by the use of chlorine compounds, but that the use of these may be an infringement of Article 21 of the Milk and Dairies Order, 1926, which states "No oxidising or preservative agent shall be used in the cleansing of any such vessel or appliance." Other methods of sterilising the rinse-water are suggested. Emphasis is also laid on the desirability of submitting all types of bottle-washing machines to a test of efficiency, carried out by some authoritative body, before they are put on the market, and on the need for a standard method for the examination of the cleanliness of bottles.

The Methylene Blue Reduction Test. The Ministry of Health, in the Milk (Special Designations) Order, 1936, introduced the methylene-blue reduction test in place of the plate count test for the grading of milk. This change gave an impetus to experimental work comparing the results obtained by the two tests, and on their comparative suitability for milk grading and advisory work. The results of some of these experiments were given in last year's review and several others are now available.

Thomas and Tudor (Ref. 46) dealing with 800 random samples —400 during winter and 400 during summer—from farms in Mid- and South Wales report that the methylene-blue test, used alone, is a much more lenient method of grading milk supplies, especially during winter, than is the combined plate

count and coliform test. They add that, when the coliform test is used in conjunction with the methylene blue test, the standard set is very similar to that of the combined colony count and coliform test as used in this country before 1937.

In the North of England, Faulds (Ref. 47) has examined 1,500 samples of milk by each of the two tests. In his view the plea that the methylene-blue test is preferable must be based on evidence that it is either simpler to perform or more accurate. He doubts its greater accuracy, but agrees that it is much easier to perform and that it saves both time and material; these economies represent only a minor saving when the cost of sampling is taken into account. In his conclusion he states that "The methylene-blue reductase test is much simpler to apply than the plate count and it yields 75 per cent. comparable results. On the whole it is a more stringent test in warm weather and less stringent in cold weather—the opposite of what is needed. The arguments in favour of its adoption are weak if the cost of the collection is taken into account. If the coliform test has to be performed in addition, the advantage of the reductase test, over the plate count and coliform test, is not so great as would appear."

In Leicestershire, Fairer (Ref. 48) has compared the results of samples taken from farms producing "Grade A" or "Accredited" milk during periods when each of the tests was in force. He states that the results, in so far as samples complying with the official standards are concerned, show no marked difference, but adds that the plate count test has the advantage that the method of stating results supplies a basis of comparison and often a stimulus to improvement. He does not wish to revert to the plate count, but suggests that some modification of the method of reporting upon the reductase test, or some change in the test itself, is desirable. This change should be designed to enable the farmer to judge whether his milk production is improving or deteriorating and in the latter case to warn him before his product actually falls below the permitted standard.

The results of an extensive co-operative experiment are given by Mattick (Ref. 49). The object was to gain experience of the methylene blue test as proposed by the Ministry of Health and to discover whether the standards set ($4\frac{1}{2}$ hours reduction time in summer and $5\frac{1}{2}$ hours in winter) approximate to those set under the plate count method. Mattick stresses the point that the official technique for the methylene blue test should be followed in every detail, and considers that it is particularly important to comply with the instructions regarding the storage of samples prior to examination. He thinks it possible that the higher percentage of failures, said to occur with the methylene

blue test, is due to neglect of instructions regarding exposure to atmospheric temperature and cold storage. An analysis of the results of the experiment does not support the contention that the failure of a higher proportion of samples condemns the methylene blue test. Mattick contends that for grading purposes, even in summer, the samples which are disqualified are justly condemned, and holds that the plate count would have disqualified a similar number. In winter no injustice is done to the producer. "Medium quality" samples are now rejected in summer but pass in winter, and the passing of the test in winter, with milk which would not pass in summer, may lead to a measure of carelessness in production which is reflected in a larger number of failures when warm weather comes.

Testing of Dairy Machinery and Apparatus.—The Agricultural Machinery Testing Committee of the Ministry of Agriculture continues to receive applications for the testing of boilers and chests designed for sterilising milk utensils on the farm. When, ten to fifteen years ago, equipment for this work became popular for farm use, almost all the boilers were coal-fired and it is significant of the trend towards a cleaner and more controllable source of heat that considerable attention has recently been directed to oil-fired and electrically heated boilers. Three types of milk utensil sterilising plants have been tested during the last two years, and a brief description of these is given in the following paragraphs :—

Barford Invicta Boiler and Sterilising Chest. (Ref. 50). This plant consists of a coal-fired boiler with the usual accessories; the water supply to the boiler is by means of a high-pressure, plunger-type, hand-feed pump or alternatively by a Penberthy Injector. The maker's rating capacity is—heavy steaming, 130 lb. of water per hour; easy steaming, 100 lb. water per hour; fuel consumption, 20 lb. of coal per hour; working pressure 80 lb. per square inch. The sterilising chest is of steel and measures 4ft. by 3ft by 4ft.; it is galvanised and is fitted with a right-hand hinged door of sheet aluminium with teak frame and quick-operating cam-type fasteners.

The report on the test states that, having regard to its type and size, the construction and standard of efficiency of the boiler are good, that it is easily installed and is suitable for general dairy and farm use. The boiler and chest form an efficient plant for sterilising dairy utensils; when operated as recommended by the makers an effective sterilising temperature (210°F.) in the chest was attained and maintained without difficulty. Sufficient steam for heating about 10 gallons of water to 180°F. in 14 minutes was also available.

Halliday Oil-fired Boiler and Sterilising Chest. (Ref. 51). This plant consists of an oil-fired steel boiler of vertical, centre-

flue type, 10 in. in diameter by 5ft. 3in. high, with a water capacity of 7 gallons. The working steam pressure is 25 lb. per square inch and the fuel consumption 1 gallon of oil in 3 hours. The sterilising chest is of steel, 3ft. by 3ft. by 2ft. 6in., on angle-iron legs. The door is teak-framed, secured at each corner and hinged at the top in such a manner that it can be partially opened to give a guarded steam vent. When fully opened the door folds back on the top of the chest. A hot-water tank of 14 gallons capacity is permanently fixed to the back of the chest. The report states that, having regard to its type and size, the standard of efficiency of the boiler is good; that it is easily installed and suitable for general dairy and farm use and that the position of the lid saves space. When the boiler and chest were operated as recommended an effective sterilising temperature (210°F.) was attained and maintained in the chest without difficulty. Sufficient steam for heating about 10 gallons of water to 180°F. in 14 minutes was also available. Both boiler and chest are soundly constructed.

Clifton Electrically Heated Steam Boiler. (Ref. 52). This boiler is of the vertical type and consists of an assemblage of two separate cylinders :—(*a*) a pressure water-feed reservoir mounted vertically and above (*b*) the boiler which is mounted horizontally, supported on a base chamber which contains the boiler; the overall dimensions are 2ft. 4in. wide by 5ft. high. The working pressure is 50 lb. per square inch. The report of the test states that the standard of efficiency is good, that it is easily installed and is suitable for general dairy and farm use. The water-feed storage system, the automatic ball valve-feed device and the spring-loaded steam-supply valve constitute an effective combination ensuring maximum working efficiency with the minimum of attention.

Taints and Flavours in Milk.

Oily or Oxidised Taints. Few problems in the dairy industry cause so much annoyance and are so difficult to solve as those arising from the presence of taints or off-flavours in milk. Some well-known taints, such as those due to the feeding of turnips and related plants, are not difficult to deal with because the taint itself indicates the source—a "turnipy" flavour is the flavour of turnips—and in such cases definite advice can be given regarding eradication. In other instances, however, the taint is described in different terms by different observers, and the descriptive words used are of no assistance whatsoever as aids to the detection of the cause. This aspect of the question is well illustrated by the recent use of the term "oxidised" to describe a taint or off-flavour, which has frequently been described as "oily" and which has also been called "cappy,"

"cardboard," "papery," "pulpy," "tallowy," "metallic," "emery," etc. Barkworth, who has recently summarised much of the available information on this subject (Ref. 53) remarks that the term "oxidised" is the designation which appears to find favour in America for the off-flavour known as "oiliness" in England, and this term may be used as a generic name for all off-flavours due to the oxidation of the fat in the milk. He adds that the speed, degree and methods of the oxidation probably all have an influence on the flavour in any given case; the milder forms may be simulated by chewing paper or bottle discs, and the worst form of the flavour is exactly like that of castor oil; except in the initial stages, the flavour is not likely to escape the notice of the consumer and when it is definite the milk must be classed as unpalatable.

This oily or oxidised taint is most likely to be due to a very small amount of copper, which is dissolved by the milk from exposed copper surfaces of strainers, coolers and other apparatus, and which facilitates the decomposition or oxidation of the fat. It may also be caused, however, by exposure of the milk to sunlight and Barkworth also reports an instance in which the milk from a number of cows developed this taint though it was milked directly into sterile glass bottles and kept at a low temperature (Ref. 54). Milks appear to vary in their "sensitivity," *i.e.*, the amount of metallic copper needed to cause a development of the taint; low temperature, which reduces bacterial action to a minimum, favours its development and it has been found equally in raw and in pasteurised milk. The practical remedies are retinning or replacement of any utensils with exposed metallic surfaces, and, where circumstances permit, avoiding the cooling of the milk to a low temperature.

Apparently this taint is a cause of greater loss and worry in the United States than in this country, but some instances are reported here in the course of every winter, and the trend of liquid milk management may lead to more frequent occurrence. Roland and his co-workers (Ref. 55) report that a study was made of the flavour, fat content, and bacteriological quality of 139 samples of commercial pasteurised milk from dairies in 19 different cities in the United States during the winter of 1935–36 with the following result:—Oxidised flavour was the predominant "off flavour" encountered, and was present in 21 per cent. of the samples; the fat content of samples showing this taint was generally higher than that of untainted samples, while bacterial counts of the tainted samples were generally lower than those of the others. Anderson and others (Ref. 56) state that this taint "is one of the most harassing problems which confronts the milk industry today." In the course of continued efforts to find a solution, they found that the taint was much more

common in milk of high acidity, *e.g.*, approaching ·18 to ·20 per cent. titratable acidity. When the acidity was naturally lower, or was reduced by the addition of a neutralising solution, the proportion of tainted samples was greatly reduced. Roadhouse (Ref. 57) is of the opinion that oxidised flavour is more common in pasteurised than in raw milk because the metals causing oxidation are more soluble in hot milk than in cold; the period of "holding" may also stimulate the rate of oxidation, but other work indicates that the storage of milk at a low temperature may be at least as great a contributing cause as the process of pasteurisation.

Other students of this subject have investigated to some extent the relation between the feeding of the cow and the susceptibility of the milk to the development of this taint. It is claimed that the feeding of a fair proportion of green food produces milk that is more stable and less subject to oxidation. The fact that the taint is practically unknown during summer supports this view. Investigations during winter by Garrett and others (Ref. 58) lead to the conclusion that a high carotene and a high ascorbic acid (vitamin C) content are coincidental to, and help to preserve, good flavour in milk and they definitely recommend that special efforts be made to preserve the carotene in hays and that a winter feeding practice be adopted which will maintain a high level of yellow colour in the milk.

Barkworth (Ref. 53) is of the opinion that it is more by good fortune than by judgment that this taint has not caused greater trouble in this country. In America, apparently, the chief cause has been metallic contamination of the milk, and possibly, as minor causes, long periods of cold storage associated with dry, indoor feeding of the cows. Should the methods of production and management in England develop in the same direction, oiliness may well become more prevalent here.

Cheese and Cheesemaking.

Farmhouse cheesemaking. In the section of this review dealing with the activities of the Milk Marketing Board, reference was made to the increase in the quantity of milk made into cheese on the farm. This increase, together with that of the previous year, shows that the steps taken, by way of subsidy have been successful in maintaining this branch of the dairy industry. Taking the last three years it is shown that the quantity of milk used on the farm for the manufacture of cheese has risen from some 15 million gallons in 1935–36 to some 21 million gallons in 1937–38—an increase of 40 per cent.

This increase is due to the fact that a proportion of the farmers, who had previously made cheese on their farms, considered that the possible returns from cheesemaking had again

become more attractive than those obtainable by milk selling. This aspect of the question has been briefly discussed by Dawe and Wragg (Ref. 59) using data collected during the summer of 1936 from 19 cheesemaking farms in Somerset. The price received for the cheese made was found to represent 8·35*d.* per gallon of milk; to this was added subsidy payments amounting to 4·46*d.* per gallon, giving a gross total of 12·81*d.* per gallon; from this figure the cost of cheesemaking—labour, materials, depreciation—of 0·89*d.* per gallon has to be deducted, giving a net return of 11·92*d.* per gallon. If the milk made into cheese had been sold as liquid milk the returns would have been 10·50*d.* per gallon, less 1·65*d.* per gallon for carriage and transit risk, giving a net return of 8·85*d.* per gallon. These figures show a net advantage in favour of cheesemaking of 3·07*d.* per gallon, to which may be added the value of the whey at, say, ½*d.* per gallon.

It is however pointed out that the variation in the price received for cheese, from farm to farm, was considerable, the extreme range being fully 3*d.* per gallon of milk. This variation was due to the varying quality of the cheese, which of course depends, in turn, on the all-round suitability of the milk for cheesemaking and on the skill of the cheesemaker. Obviously, the producer of the best cheese obtained a still larger balance over the liquid-milk price. Such results should stimulate those engaged in farm cheesemaking to produce the highest possible quality of cheese. Since 1936 the subsidy has been lowered, but the fall is compensated by the increase in the market value of cheese.

One of the essentials to the production of high-grade cheese is milk of good quality, free from contaminating bacteria. Participation in the Accredited Scheme should be of assistance in raising the hygienic standard of the milk, and it is interesting to note that about 30 per cent. of the farmhouse cheesemakers qualified as producers of "Accredited" milk during 1937–38 (Ref. 1). Another invaluable aid to the making of a good cheese is the possession and use of a starter of correct flavour and full vitality. This subject has been dealt with fully by Davis (Ref. 60) who describes in detail the choice of milk, utensils and methods for the successful propagation of a starter, discusses the chief forms of contamination which may occur and the causes of a fairly common defect—slowness of action. Davis also outlines simple practical tests which can be applied to milk, by the cheesemaker, in order to determine its suitability for the propagation of starters and for manufacture into cheese.

Good progress has also been made by the National Mark Scheme for the grading and marking of cheese. According to a leaflet (Ref. 61) issued by the Ministry of Agriculture, National

Mark Schemes are in operation for the varieties of cheese mentioned below; the grade definitions "Extra Selected," "Selected," etc., are National quality standards, and apply equally to the creamery and farm product.

Cheddar	Extra Selected and Selected.
Cheshire	Extra Selected and Selected.
Derby	Selected.
Lancashire	Selected.
Leicester	Selected.
Caerphilly	Selected.
Stilton	Extra Selected (Blue), Selected (Blue) and Selected (White).
Wensleydale	Selected (White).
Cream Cheese	Extra Selected (Double Cream) and Selected.

Full details of the operation of the Scheme, of the regulations which must be complied with, and the quality descriptions of each variety, are given in the above-mentioned leaflet.

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THE FEEDING OF LIVE-STOCK.

DIETARY CONSTITUENTS.

(1) MINERAL SUPPLY.

Calcium and phosphorus. One is often asked whether rock phosphate can take the place of bone meal as a mineral supplement for live-stock. The answer to this question should take into account the recent findings of workers at the Onderstepoort Institute in South Africa (Ref. 1). Several earlier observers have reported cases of abnormal development, particularly in respect of bones and teeth, and other detrimental effects from the use of rock phosphate, but at the Onderstepoort Station definite toxic effects have been obtained by feeding this mineral to cattle. The injurious effect of the rock phosphate has invariably been attributed to its content of fluorides.

Fluorine consumed by the animal accumulates in the bones and teeth. Certain workers have postulated that this element plays a part in normal calcification, but so far no definite proof has been advanced as to its being essential for any physiological process, even though it is always present, in traces, in bones and teeth. It has been established in the Onderstepoort trials that both rats and cattle will continue to retain appreciable amounts of fluorine when subsisting on rations to which small quantities of fluorides have been added. Cattle were found to retain approximately 0·2 gm. and rats 1 mg. per day. Under such conditions of continuous storage it seems possible that the tissues may in time become almost saturated with this element and unable to cope with a further influx. At this limit the natural functioning of the tissues may be upset so seriously that death may result as a consequence of fluorine poisoning.

Another important result is the observation that fluorine may lead to a serious disturbance of the calcium and phosphorus metabolism in cattle, causing a slight increase in the retention of calcium but a pronounced decrease in the phosphorus retention. The effect is so marked as to warrant the assumption that the continued presence of fluorine in the diet might ultimately occasion a condition of phosphorus shortage. If this should be the case, the authors conclude, there can be no doubt that the fluorine problem has a special practical importance, and that fluorine-containing mineral phosphate, when fed to live-stock as a substitute for bone meal, may actually help to bring about nutritional disorders such as rickets, instead of acting as a preventive.

The disadvantages of mineral phosphate as a mineral feed for live-stock are further emphasized by work at Illinois on the use of calcium and phosphorus supplements for growing pigs (Ref. 2). Rock phosphate, containing 3·8 per cent. of fluorine, fed in an amount sufficient to provide 5 gm. of calcium daily as a supplement to a calcium-deficient diet, exerted definite toxic effects on pigs after variable periods of feeding. The toxic effects were, moreover, of a cumulative nature, since with a constant daily dose the symptoms (poor appetite, swellings on the loin, scouring, stiffness, etc.) appeared only in the later stages of the trial. For all pigs on test for as long as 24 weeks the poorer growth of the rock phosphate pigs, as compared with the pigs receiving pure tricalcic phosphate, was marked. It was also established that the fluorine in rock phosphate is more toxic than that in calcium fluoride, probably because of the different form in which it occurs.

From the Onderstepoort Institute comes an interesting account of investigations into the influence of variations in the dietary phosphorus and in the calcium : phosphorus ratio on the production of rickets in cattle (Ref. 3). Young heifers and bullocks were fed basal rations supplemented with chalk and sodium phosphate in such a way that the intakes of calcium and phosphorus were varied according to a definite plan in the respective groups, the object of the experiments being to study the effect of phosphorus deficiency and sufficiency in rations containing varying amounts of calcium. Vitamin D was present in abundance in all the rations. The experiments continued for approximately two years.

The outstanding result of the trials was that, under these conditions, phosphorus deficiency invariably led to rickets or osteomalacia, and that the effects of phosphorus deficiency were aggravated by a relatively high calcium content in the diet. It is pointed out that this latter finding is of considerable practical importance, since phosphorus deficiency in pasture is frequently

associated with high calcium content. A daily intake of 19 gm. P_2O_5, of which 53 per cent. was retained by the steers, and of 24 gm. P_2O_5, with a retention of 63 per cent. by the heifers, provided sufficient phosphorus for normal growth and development, whilst 13 gm. and 10 gm. proved insufficient for the bullocks and heifers respectively. The decreased food consumption that has invariably been observed in cattle receiving insufficient amounts of phosphorus in their diets is held to be due not wholly to the inadequacy of the phosphorus but is also associated with the calcium content, and is probably an effect of a disturbance of the calcium-phosphorus metabolism of the animal. Apparently a favourable ratio of calcium to phosphorus, when the latter is present in insufficient amount, does not affect the appetite detrimentally to any appreciable extent.

A peculiar instance of disadvantageous influence arising from an excessive supply of carbonate of lime in the rations of chickens is brought to light by the results of recent American trials (Ref. 4). Experience at Wisconsin has shown that when chicks are given hopper-fed, chick-size limestone grit or oyster shell, the consumption will vary from 1 to 4 per cent. of the ration. Chicks receiving an insufficient amount of vitamin D will consume more of the mineral than those having access to direct sunshine or receiving an ample supply of vitamin D as cod liver oil. It would appear, however, that an unduly high percentage of limestone grit or oyster shell in the diet has the effect of increasing the susceptibility of chickens to coccidiosis. Results are brought forward showing that the addition of 6 per cent. of chick-size oyster shell to a control ration containing 0·87 and 0·93 per cent. of calcium and phosphorus respectively led to a significant increase in mortality following infection with coccidiosis. It may be added that workers in Pennsylvania stress the great value of feeding adequate amounts of cod liver oil in helping to overcome the detrimental effects brought about by infestations of coccidia (Ref. 5).

In view of the contradictory results that have been published from time to time concerning the relative efficiencies of dicalcic phosphate and feeding bone flour as supplements for phosphorus-deficient rations, the results of feeding trials carried out recently at the Rowett Research Institute are of special interest (Ref. 6). Balance trials and blood investigations were made with sheep subsisting on a basal ration which was markedly deficient in phosphorus, being composed of a mixture of chopped oat straw, dried beet pulp, starch and feeding blood meal. To this ration were added, in successive periods of measurements, dicalcic phosphate and steamed bone flour in such quantities as to supply equal amounts of phosphoric acid.

With either supplement the sheep, which on the basal diet

had shown a blood picture definitely indicative of phosphorus deficiency, rapidly returned to normal and displayed normal levels for blood and serum inorganic phosphorus and serum calcium and phosphatase. On the basis of the balance tests, it would appear that the phosphorus supplied in the form of dicalcic phosphate is utilised to an extent approximately 50 per cent. greater than when supplied in the form of steamed bone flour. Further, dicalcic phosphate, when added to a phosphorus-deficient ration, would seem to exert a more favourable effect on nitrogen assimilation than does steamed bone flour.

Many readers will recall the fashion of a generation ago for drinking sour milk or buttermilk as a means of improving one's prospects of longevity. We were told that in the large intestine there flourished a type of putrefactive bacteria which had, as their main function, the production of toxic nitrogenous substances from protein residues left over from food digestion. These were the substances that caused the headaches characteristic of constipation and, in the long run, were responsible for arterial sclerosis and senile decay. The drinking of sour milk, according to Professor Metchnikoff, of Paris, who was the leading exponent of this vogue, altered the conditions of the intestine in such a way that the harmless lactic fermentation became dominant and held in subjection all forms of injurious fermentation. Under these conditions, therefore, the harmful substances which, by their action on the arteries, tended to circumscribe existence unduly, could not be produced. Be that as it may, the excitement caused by this lively controversy has been dead these many years. For one thing, Metchnikoff himself has gone the way of all flesh; and perhaps the drinking of sour milk was considered too high a price to pay for longevity.

Memories of this vogue are revived by the recognition, in recent biochemical research, of the favourable influence exerted by milk sugar (lactose) on the utilisation of calcium and phosphorus in the body. There are many indications in the literature that the various sugars, when ingested separately and without admixture with other nutrients, differ in the rate with which they are oxidised or are converted into glycogen or fat; but in its favourable effect upon the absorption and utilisation of calcium and phosphorus, lactose appears to stand apart from all the other sugars. It has been shown that the feeding of lactose brings about changes in the *p*H of the contents of the whole intestinal tract below the duodenum and favours the development of acid-tolerant micro-organisms in much the same way as the drinking of sour milk induces the lactic fermentation in the intestine. Whether the effect of lactose is specific or merely the result of an increased solubility of calcium salts in the more acidic medium is at present a debatable point.

In experiments at Urbana the influence of different sugars (sucrose, glucose, fructose and lactose) on metabolism in rats was investigated (Ref. 7). The various rations were made up to contain 60–70 per cent. of the sugars, precautions being taken to ensure that the rations were adequately balanced and equal in content of protein and energy. It was observed that the lactose, in comparison with the other sugars, caused a reduction in the extent to which the rats digested and absorbed the organic components of the ration, this being associated with smaller gains in live-weight by the lactose rats. Nevertheless, the latter, growing at a rate equal to only 60 per cent. of that of their glucose controls, deposited 97 per cent. as much calcium and 94 per cent. as much phosphorus in their bodies. On an equal empty weight basis, their carcasses contained 28 per cent. more calcium and 21 per cent. more phosphorus than those of the comparable rats fed on the glucose ration.

Further work on these lines at Yale has led to the suggestion that the lactose effect on calcium and phosphorus metabolism is exerted more strongly in the very young animal than in the more mature organism, and that lactose may cause this greater storage of calcium by diminishing the losses from the blood stream into the large intestine (Ref. 8). It is interesting to reflect, therefore, that milk, on which the infant animal must rely for supplies of calcium and phosphorus for the process of building up the skeletal structure, also furnishes the correct sugar for enabling the organism to utilise these mineral constituents with the maximum efficiency.

Manganese, Zinc and Aluminium. The anatomical deformity of the leg bones of young battery-fed chickens, known commonly as "slipped tendons" or "enlarged hocks" and more recently as perosis, has received a great deal of attention at the hands of workers in the United States during the past year. The literature of the subject has indicated clearly that the problem is a nutritional one. It was believed at one time that the condition was closely related to rickets, but it is now recognised that the factors responsible for the cause and cure of rickets are not effective in perosis; indeed, excessive lime and phosphate supply, if of any importance at all, appears merely to aggravate this disorder.

Results of great interest have been obtained recently by Wilgus *et al* in their studies of the factors involved in the causation and prevention of perosis (Ref. 9). Day-old chicks were confined on wire floors in electrically-heated battery brooders for an experimental period of six weeks. The basal diet consisted of 63·5 per cent. of yellow maize meal, 5 of lucerne meal, 20 of dried skim milk, 10 of "menhaden" fish meal, $\frac{1}{2}$ of iodized salt, $\frac{1}{4}$ of cod liver oil and $\frac{3}{4}$ per cent. of cotton seed oil. The ration

contained 20 per cent. of protein, 0·95 per cent. of calcium and 0·8 per cent. of phosphorus. To this basal food were added varying percentages of steamed bone meal, the calcium : phosphorus ratio being held at 1·5 : 1 by the use of limestone. Severe perosis occurred among the young chicks when the level of mineral content reached 1·5 per cent. calcium and 1 per cent. phosphorus.

The effectiveness of various sources of lime and phosphate in producing perosis was next investigated. Pure forms of calcium carbonate, hydroxide and chloride, as well as pure mono-, di- and tri-calcic phosphates, increased the severity of the perosis to about the same extent as did steamed bone flour when added to a basal ration low in the preventive factor. On the other hand, however, an impure, commercial sample of mono-calcic phosphate was found to possess a marked preventive action.

It became evident that the perosis-preventing power was associated with the impurities in the commercial phosphate, and the effect was traced in further inquiries to the influence of a small amount of manganese impurity (Ref. 10). It was demonstrated that the presence in the diet of a trace of manganese is essential to the prevention of perosis in young chicks. The addition, in the form of chloride, of as little as 0·0025 to 0·015 per cent. of manganese to a diet already containing 0·001 per cent. of this element was sufficient to prevent perosis. Zinc and aluminium were found also to possess a similar property, but were somewhat less effective. The curative properties of certain foods and rations (*e.g.* rice bran) were shown to be correlated with their manganese content (Ref. 11).

In a still more recent publication the effect of intra-peritoneal injections of manganese (as aqueous solution of sulphate containing 0·15 mg. of manganese per c.c.), iron, zinc and aluminium on the occurrence of slipped tendon in young, growing chicks is reported. When administered in the proper amount, manganese was effective in the prevention of the disorder, whereas zinc, aluminium and iron failed to show any protective action. It is important to note, however, that if the amount of manganese injected was not kept down to the optimum low level, retardation of growth resulted. (Ref. 12.)

Iron and Copper. Only about 0·004 per cent. of the weight of a normal adult animal is iron, but the fundamental importance of this element is far greater than this low content would seem to indicate. Its vital rôles in the oxidation-reduction processes of the body cells and in the transportation of oxygen in the blood mark out this element as one of the most important factors of nutrition. There are no great reserves of iron in the body such as exist in the bones for calcium and phosphorus, and for that

reason the constant loss by wear and tear must be made good in the diet.

The infant animal is born with a reserve of iron. The latter, however, soon begins to be depleted, since milk is deficient in both iron and copper. Severe anæmia may be produced in young rats within two weeks if precautions be taken to prevent them from receiving any food other than liquid milk. Before the initial iron reserve is used up, therefore, it is imperative, with the young of all species, be it man, pig or mouse, to supplement the milk with iron-containing foods.

The necessity for traces of copper compounds as a supplement to iron for the synthesis of hæmoglobin in the body was first demonstrated by Hart *et al* (Ref. 13). Pig feeders are familiar with the iron sulphate-copper sulphate treatment for anæmia in young pigs. It is now recognised that the copper does not influence the absorption and assimilation of iron, but is in some way indispensable in the process of converting the iron into hæmoglobin. In other words, iron stored in the body cannot be used for building up hæmoglobin unless copper is also available. This has been illustrated strikingly in recent American experiments (Ref. 14). Young rats were rendered anæmic by being kept solely on whole milk after weaning. The anæmic rats were found still to have a reserve of iron which could be converted into hæmoglobin when the milk was later supplemented with copper. As would be expected, the iron reserves of the body were much more completely used up when the rats were made anæmic on whole milk containing traces of copper salts than when the diet consisted of milk alone.

Interesting metabolic experiments have been carried out recently on anæmic rats at Pennsylvania (Ref. 15). Young, growing albino rats were used for comparing the influence on metabolism of an iron- and copper-deficient diet (whole milk powder) with that of the same diet supplemented with small amounts of iron and copper salts. Feeding was controlled by the paired-feeding technique. The rats on the unsupplemented milk powder promptly developed the typical symptoms of nutritional anæmia. They were found, rather surprisingly perhaps, to assimilate a higher proportion of the energy and protein in the ration, to produce more heat and to store more water than did the rats receiving the iron-copper supplement; but despite this, the latter dealt with the assimilated nutriment much more efficiently, making greater gains of body weight and actually storing more energy, protein and fat, although, of course, they consumed the same quantities of protein and energy as the anæmic rats with which they were paired. The hearts, spleens and kidneys of the iron- and copper-deficient rats were generally much enlarged.

Molybdenum. A recent communication (Ref. 16) has thrown light on a problem that has long puzzled the nutritional chemist. A large area under pasture in Somerset cannot be grazed by cows during the normal grazing season without rapid decline of milk yield and serious loss of condition, accompanied by severe scouring. Such fields are described as being "teart," and the area involved is estimated at about 20,000 acres. The available information rules out bacteria, parasites, water supply or a particular herb as causal agents.

Systematic examination of "teart" and "non-teart" fields has now disclosed the fact that the molybdenum content of "teart" herbage is considerably higher than that of the "non-teart" fields situated close by. Soluble molybdates in quantities equivalent to those provided in an average daily ration of really "teart" herbage (1·36 gm. Mo per head per day) have been fed to 5 dry cows at Jealott's Hill, and in three cases scouring and loss of condition similar to those occurring on "teart" fields have been noted. Whether the molybdenum is directly responsible, or whether it activates catalytically a toxic product in the rumen, is not as yet clear. The investigation is still being pursued and further results will be awaited with great interest.

Cobalt. Those readers who may be interested in the results of recent Australian research on the use of supplements containing traces of cobalt salts for the prevention of bush sickness should consult a recent article by Marston and his colleagues dealing with the course of events that led up to this remarkable discovery (Ref. 17). Filmer and Underwood have also continued their pioneer investigations into the use of cobalt as a cure for a similar malady, enzootic marasmus, affecting both cattle and sheep grazed continually over certain highly ferruginous sandy loams of the Denmark district of Western Australia. They have now demonstrated that sheep may be cured of the disease and maintained in good health by the administration of cobalt chloride in doses which supply as little as 0·1 mg. Co daily, the corresponding amount required for cure in cattle being no more than 0·3 to 1·0 mg. Co daily. (Ref. 18.)

(2) Protein Supply.

Protein Quality. It is not necessary to write at length on this subject, since it has been dealt with very fully by Dr. Crowther from time to time. Although by now we are all familiar with the idea of protein quality in relation to live-weight increase and milk production, it may seem strange to be told that a protein supply which is deficient in quality from the standpoint of amino acid make-up may influence the sexual behaviour of animals. It was shown some years ago that when rats were kept on a diet containing gliadine as the main source of protein, they failed

to ovulate; from this it was concluded that the amino acid lysine, in which gliadine is seriously deficient, was necessary for ovulation (Ref. 19). At a later date the effect of a lysine-deficient diet, containing 18 per cent. of the wheat protein gliadine as the sole source of protein, on the sexual behaviour of rats was investigated. Apart from the imperfect quality of the protein supply, the ration contained all the constituents essential for growth. Rats subsisting on this diet remained in anœstrum, but the simple addition of lysine to the ration caused resumption of normal oestrous cycles (Ref. 20).

Further work at Madison has shown that a deficiency of amino acids other than lysine may cause an aberration of the oestrous cycle (Ref. 21). Indeed, it would appear that when the quality of the dietary protein is inadequate for normal growth, the sexual behaviour may likewise be influenced adversely. There is, of course, no question of permanent sterility resulting from feeding diets quantitatively or qualitatively deficient in protein, the condition being promptly restored to normal when the necessary stimulus for ovulation, in the form of protein of adequate quality, is provided in the diet.

Non-protein Nitrogenous Constituents ("*Amides*"). The question of the feeding value of amides and ammonium compounds, whether present naturally in feeding stuffs or as deliberate additions to the diet, has been the subject of a large number of investigations, particularly in Germany, during recent years. It is claimed that ruminants like sheep and cattle (but not non-ruminants such as the pig) are able to utilise these simple nitrogenous compounds in partial satisfaction of their requirements for protein, and that even an amide such as urea, which normally has to be eliminated from the blood into the urine as a toxic product of protein metabolism, is able, when present in the rations of sheep and cattle, to function as a substitute for food protein.

The plant alone has the power of elaborating complex protein from such simple forms of nitrogen compounds; this power is shared by the micro-flora that flourish in the rumen or first stomach. These bacteria assimilate the amide substances, transforming the nitrogen part into their own component protein. Following the decease of the bacteria, this protein becomes available to the animal host and undergoes digestion and absorption like ordinary food protein. It may be observed that the value of such "bacterial protein" must depend on its biological efficiency (quality) as governed by its amino acid make-up, but on this point nothing appears to be known at present.

It might be thought that the most natural way of transforming an amide like urea into flesh or milk protein would be

to apply it as a fertiliser on pastures, so that its nitrogen might first of all be converted into herbage protein, the next step being to allow cattle or sheep to graze the pastures. The German scientist, however, is now seeking to "short-circuit" the process by feeding the urea direct, thus calling on the micro-flora of the rumen to do the work of the pasture plants in converting the amide nitrogen into protein. Queer "protein concentrates" have made their appearance recently, consisting of absorbent foods, like potato flakes, sugar beet pulp, molassed bran and linseed cake, in which some 15 to 17 per cent. of synthetic urea has been incorporated. They are known as "urea or amide foods," and it is hoped that their introduction into feeding practice, if found feasible, will result in a substantial reduction of the quantity of protein foods imported into Germany. Digestion and nitrogen balance trials with foods of this nature have been carried out at several centres (Refs. 22, 23 and 24). Sheep were given, during the period of the trials, rations containing as much as 200 gm. per day of the "urea-foods," apparently without harmful effect. When added to a basal diet of hay, the "urea-food" led to an increase in nitrogen retention in the sheep. It appeared that the urea was almost fully assimilated and that the digestibility of the absorbent food was in no way affected by the presence of the amide. In further nitrogen balance trials, in which food protein was partially replaced by urea in the rations of young, growing cattle, it seemed justifiable to conclude that 50 gm. urea plus 200 gm. starch had been able to take the place of 200 gm. gluten protein (Ref. 25).

The results of such short-period balance trials may be very misleading, however. There is no assurance that the nitrogen retained during the periods of urea feeding is actually stored up as body protein in the tissues; indeed, it may serve merely to increase the non-protein nitrogen content of the blood and tissues. What is wanted is a full-scale, long-period feeding trial showing actual records of live-weight increase of sheep and cattle subsisting on rations in which part of the protein requirement is supplied in the form of urea. Such evidence unfortunately is not available. The feeding of urea, moreover, may conceivably be harmful if amounts beyond the assimilative powers of the rumen bacteria should be ingested. The excess would presumably be absorbed into the blood stream unchanged, and this would throw an extra strain on the kidneys in their normal task of eliminating urea from the body.

In a recent critical review of the whole question (Ref. 26), Kurt Krebs expresses doubt as to whether the rumen micro-flora are able, on any marked scale, to synthesise protein from amide substances. Even if they are able to do this, it seems possible that the presence of anti-enzymes in the micro-

organisms might prevent the eventual digestion of the bacterial protein in the alimentary tract. Ingested non-protein, such as urea, admittedly exerts a stimulating influence on milk production, but this should be explained on the grounds of its protein-sparing rather than its protein-substituting effect; that is to say, the nitrogen of the urea is not converted eventually into milk protein, but by bearing the brunt of the bacterial attack in the rumen, the urea in the diet enables a more efficient use to be made of the true protein in the feeding stuffs constituting the ration. *In the presence of urea, therefore, a ruminant is able to make much better use of a protein-deficient diet than it otherwise would do.* Krebs calls attention to the fact that the addition of glycine, which is a simple amino acid contained in most proteins, and might therefore have been expected to have shown a positive effect, has no stimulating effect on milk production, although it apparently causes a slight increase in the percentage of fat in the milk.

Schmidt *et al* (Ref. 27) noted, moreover, that with growing lambs up to 90 lb. live-weight, glycine is unable either to exert a protein-sparing effect or to function as a substitute for food protein. From 55 to 90 lb. live-weight, the addition of glycine appeared to be without either favourable or injurious effect, but in the case of younger lambs, both food intake and growth rate were thereby adversely affected. To sum up: whilst it may be admitted that this subject of the value of amides and ammonium salts as possible protein substitutes in ruminant dietaries is of undeniable interest to the biochemist, it must be confessed that, as to its practical outcome in animal husbandry, the reader would do well to keep an open mind for some time to come.

(3) Vitamin Supply.

The stream of vitamin research continues to flow strongly. New vitamins are being brought to light, whilst old-established vitamins are being split up into a number of separate factors with distinctive functions. Much of this work is still in the developmental stage and has as yet little interest for the farmer; but note may be taken of a number of recent investigations, the results of which impinge directly on feeding practice.

Vitamins and Pig-feeding. A fascinating contribution to our knowledge of this subject has been published conjointly by workers at Cambridge and at the Lister Institute (Ref. 28). Young weanling pigs were kept on a diet composed of 83 parts ground *white* maize, 11 parts pea meal, 4·4 parts *highly purified* casein, 3 parts cod liver oil and 2½ parts of a suitable mineral mixture. The diet was similar to those that have been used to produce " black tongue " in dogs and was modelled on diets associated with the production of human pellagra.

The pigs became ill with severe diarrhoea in 5–10 weeks and showed a progressive simple anæmia. Death occurred ultimately unless the deficiencies of the diet were made good. For example, the diet was rendered satisfactory for rearing young pigs when 4–8 per cent. of dried yeast was included, the proportion of casein being lowered to keep the protein level at 11·1 per cent. On this modified diet, the pigs made uninterrupted growth with an average daily increase of $1\frac{1}{4}$ lb. Further, the inclusion of dried yeast (or its aqueous extract) effected really dramatic cures of animals that had become seriously ill on the deficient diet. It was concluded that the nutritive failure of the above maize diet for rearing young pigs was not due to defects in the amount or quality of the protein, but to a deficiency in some constituent of the heat-stable portion of the vitamin B complex. Since no advantage was secured by the daily administration of 2 mg. of lactoflavin, it was probable that the missing factor was the constituent of the B complex known as the pellagra-preventing vitamin. The remedial effect of the yeast was to be ascribed to its richness in this accessory factor. The replacement of the white maize by a mixture of wheat and barley rendered the ration just satisfactory for growth in young pigs, from which it is apparent that this cereal mixture, unlike maize, supplied just sufficient of the anti-pellagraic vitamin to support health and growth.

It should be noted particularly that the protein supplement consisted of chemically-pure casein, entirely freed from traces of any other milk constituents or vitamins. Such a product would naturally not be used in practical pig-feeding, and the disorders of malnutrition experienced in these experiments would not be encountered when the "natural" protein supplements, such as liquid or dried separated milk, white fish meal, meat meal, etc., were used in conjunction with cereals and weatings. The work is nevertheless of great interest in demonstrating the marked susceptibility of young pigs to deficiency of the pellagra-preventing factor.

The sequel to the foregoing investigation is provided by a later paper (Ref. 29), in which are described seemingly miraculous cures of pellagra in pigs by the administration of small doses of nicotinic acid. In one typical case a gilt, which after 17 weeks on the maize-casein diet weighed only 36 lb. at 6 months of age and was literally "at death's door," was given the nicotinic acid treatment. The effect was striking. The appetite returned within 24 hours of the first administration, the diarrhœa abated and the scabs on the skin began to be detached after one week, leaving clean, healthy skin. Three months later she weighed 129 lb. and was a normal flourishing animal. The diet had been the same during this interval except that 60 mg. of nicotinic

acid had been added to the daily ration, and the results amply confirm the findings of other workers that nicotinic acid or its amide is the active constituent of the pellagra-preventive factor (Ref. 30).

Still more recently a colorimetric method for the estimation of nicotinic acid in feeding stuffs has been developed (Ref. 31). The method has been applied to 12 feeding stuffs. Dried yeast easily heads the list with as much as 62·5 mg. of nicotinic acid per 100 gm.; then comes skim milk powder with 10·5 mg., whole wheat with 5·3 mg. and lowest of all, white maize with but 1·5 mg. per 100 gm.

Vitamins in Milk. The problem of securing a milk supply of high vitamin content and growth-promoting power is one of national importance. It has been customary to assume without question that, of all foods available for the nutrition of the dairy cow, summer pasturage, on account of its own all-round content of vitamins, leads to the greatest enhancement of the vitamin potency of milk. It seems, however, that this simple, clear-cut view may have to be modified in certain respects.

Reference was made in last year's *Guide* to the findings of workers at Reading that the higher anti-rachitic power of summer milk must not be attributed to the influence of the vitamin D content of pasturage (which, by the way, is not very considerable) but to the influence of the direct exposure of the cow to sun-shine and sky-shine. Indeed, good hay which has, during its curing in the field, been subjected to irradiation from sun and sky, may be a richer source of vitamin D than fresh pasture grass (Ref. 32).

Now comes a further publication from the same Institute in which it is demonstrated that the level of the anti-scorbutic vitamin C in mixed milk is remarkably constant and independent of the season or the nutrition of the cow (Ref. 33); neither was any evidence obtained of any effect of pasture feeding in spring on the vitamin C content of the milk.

It would appear also from recent work that the amount of the vitamin B complex, which is capable of being produced in the rumen of the cow by bacterial synthesis, remains fairly constant in milk throughout the year, the level being raised only slightly when cows have access to pasture or are given vitamin B-rich foods such as yeast in their diet. With vitamin A, however, the case is different, and it is now generally recognised that fresh pasturage in summer, or artificially-dried grass in winter, will maintain an enhanced carotene and vitamin A content in milk. When we speak of the effect of pasture on the vitamin potency of milk, therefore, it appears that we should think merely in terms of vitamin A and its precursor, carotene;

but perhaps the foregoing results may not represent the last word on this important question.

The relative vitamin potencies of colostrum and normal milk continue to attract the attention of nutritional workers. It is now generally known that cow's colostrum is very much richer in vitamin A and carotene than the later milk (Ref. 34). Recent work at Reading has shown, however, that the anti-scorbutic activity (vitamin C) of colostrum is only slightly higher than that of milk (Ref. 33). In respect of anti-rachitic properties (vitamin D), the first-drawn colostrum of a Guernsey cow, which had been on pasture during summer until two days before calving, was found to be some three times more potent than the later milk. It was shown in this investigation that the difference between the colostrum and the normal milk was in summer 3–4 times less pronounced in the case of vitamin D than in the cases of vitamin A and of carotene (Ref. 35).

Since milk is not a specially good source of vitamin D, it is not surprising that attempts have been made to increase its anti-rachitic properties by ultra-violet radiation, the ergosterol precursor in the milk being thereby transformed into the vitamin. Such "vitaminised milk" has been used in the prevention and cure of rickets in children, but the process has the disadvantage that prolonged irradiation in the presence of dissolved air imparts an unpleasant odour and taste to the milk and may, moreover, lead to the partial destruction of vitamin A and the total inactivation of vitamin C. A high level of ergosterol in the milk might, it was thought, make it possible to obviate too prolonged an irradiation.

Recent American work, however, has shown that the activability of milk by irradiation from the mercury-vapour lamp cannot be increased by feeding ergosterol (either dissolved in oil or in the form of yeast) in the diet of the cow with a view to increasing the concentration of this vitamin-D precursor in the milk (Ref. 36). Unlike cholesterol, the animal sterol, it would appear that ergosterol, the characteristic sterol of fungi like yeast and ergot, is not absorbed from the animal intestinal tract, although in birds this absorption undoubtedly does occur. In the case of the hen, for example, the ergosterol content of the egg yolk has been raised significantly from the normal 0·0018 per cent. to 0·0027 per cent. by including 50 mg. of ergosterol in the daily food (Ref. 37).

The direct addition of ergosterol to milk naturally increases its activability. Additions of 0·42 mg. per quart resulted in the milk attaining more than twice the anti-rachitic potency of normal milk when the two were given comparable exposures to ultra-violet light. The vitamin-D content of milk could be increased directly by including preparations rich in this factor

in the diet of the cow, and it is interesting to note that the feeding of this vitamin in the form of irradiated yeast was from 2 to 3 times more effective in the production of "vitamin D milk" than when it was administered as irradiated ergosterol dissolved in oil.

GRASS AND FORAGE CROPS.

Grass-drying. Writing as one who was primarily responsible for troubling the agricultural world with the idea of grass-drying, I must confess to some disappointment at the manner in which the conception is being tried out in practice. There has been too much talk of grass-drying as an alternative to hay-making; too much reference to "super-hay," and apparently too little enthusiasm for testing the proposal in its original form, namely, that of drying *young, leafy grass* for the production of a food of concentrate value.

I have no great prejudice against the use of the process for making "super-hay," provided the product is really of the quality implied in the name, since such a fodder is able to contribute to the production processes as well as supply the requirements for maintenance. Do not let us use this new method of conservation, however, merely to increase the store of roughage in the world, but rather to produce that ideal winter concentrate which only young grass can provide. If we are concerned about the supple of roughage, let this be increased through the medium of the traditional hay-making procedure, since hay made by artificial-drying can only in exceptional circumstances be regarded as an economical food in winter-feeding.

We are, I fear, tending to become dangerously dependent on oil-seed products for supplying the protein required in the winter rations of dairy cattle. It may be urged that oil cakes are the necessary by-products of a process for deriving a commodity of primary value, and that, as such, they must inevitably come on to the agricultural market. The peril, however, lies in the possibility of circumstances arising in which such products might not be procurable, and that we might by that time have almost forgotten how home-grown produce can be used to make up efficient rations for milk production. For this reason it is perhaps to be regretted that farmers in this country are not taking a greater interest in the improved methods of ensilage, such as the molasses process, which enable young grass and other protein-rich fodders to be conserved in a satisfactory manner. The reader will find these new methods of ensilage discussed in full detail in the recently issued fourth edition of the Ministry of Agriculture's bulletin on ensilage (Ref. 38). Every British farmer should study the problem of how he would continue to feed his dairy cattle efficiently on

home-grown foods in the event of his being unable to purchase protein concentrates of imported origin. This is a problem that is not being neglected in certain countries on the Continent!

Dr. Crowther made an extended reference last year to the present position of grass-drying and its sister process, ensilage, so that little need be added in this year's *Guide*. Among publications in the period under review may be mentioned one in which it is shown that, for the partial replacement of an ordinary winter ration for dairy cows, "extracted" dried grass, as made by the process used by R. G. Foods, Ltd., appears to be as useful as dried grass made by the orthodox methods (Ref. 39). In an illuminating paper by Principal Paterson, received too late for detailed survey, it is shown that dried young grass of high quality more than held its own in comparison with a high-grade concentrate mixture in cattle- and sheep-feeding trials (Ref. 40). This publication will be given further consideration in next year's *Guide*.

The general question of the feeding of dried young grass to live-stock has been dealt with in an extremely useful publication by Dr. S. J. Watson (Ref. 41) and in a further paper, of which a few copies still remain over for distribution, by the present writer (Ref. 42).

The Grass-juice Factor. Recent American research has proved that there is present in grass, particularly in young, quickly-growing grass, some growth factor that passes over into the milk and increases very remarkably its growth-promoting properties (Ref. 43). It is held that the absence of this factor from ordinary winter milk accounts for its lower growth-promoting potency as compared with milk produced by dairy cows on summer pasture. The feeding of 3 c.c. of grass juice per day to rats on winter milk was found to stimulate growth to a level comparable with that manifested on summer milk.

The identity of this grass-juice factor is not as yet established, but experiments have shown that it is quite distinct from any of the known vitamin factors. The authors make the suggestion that the well-known stimulation of milk-flow observed when dairy cows, after a long winter indoors, are turned out on to spring pasturage is to be ascribed to the influence of this new factor; but this, for the time being, must remain a mere speculation. What is important, however, is the finding that the unknown growth factor is retained in carefully-dried young grass, a discovery that naturally must lend additional weight to the arguments already put forward in favour of this method of grass conservation.

The Carbohydrate of Young Grass. Preliminary experiments at Rothamsted on the developmental changes in the composition of ryegrass revealed a number of interesting features, not the

least of which was the presence, in considerable amount, of a water-soluble and highly-available carbohydrate, known as fructosan, in the young grass (Ref. 44). A more detailed investigation, involving the examination of samples of herbage cut at weekly intervals, has now been undertaken. The presence of fructosan as a major constituent of young grass, and its disappearance as the herbage grows mature, have been fully confirmed. The percentage at the peak value may amount to as much as 30 per cent. of the dry substance in the grass (Ref. 45).

Unlike the cereals, which also contain fructosan in the early stages of growth, ryegrass does not store any considerable amount of carbohydrate in the seed. Instead of being utilized for transformation into starch, the fructosan in the grass is presumably used up in forwarding the general development of the maturing plant. There is a strong indication that the structural constituents, and in particular the cellulose, which continue to increase in amount after the dry weight of the plant has attained its maximum, do so at the expense of the fructosan. It need scarcely be pointed out that this is a retrograde process from the standpoint of nutrition. Here, then, is a further strong argument for the utilization of grass, whether for grazing or for artificial drying, in its young stage of growth, when both the carbohydrate and the protein are in their most valuable and available forms.

DIGESTION AND METABOLISM.

Net Energy. Readers are now familiar with the two rival systems for expressing food values and food requirements, namely, the net energy system of Armsby and the starch equivalent system of Kellner. Some very candid opinions on these systems have recently been expressed by American scientists at the 1937 meetings of the American Society of Animal Production. Prof. Morrison (Ref. 46) pointed out that, in contrast to the conditions in many European countries where starch equivalents have long been accepted as the basis of feeding, net energy values have not yet been generally adopted in the United States, the majority of investigators and teachers having preferred to use instead the method of measuring food values in terms of total digestible nutrients, despite the lesser accuracy of the latter form of expressing feeding values.

This slowness to adopt net energy values is probably due to two reasons: (1) very few actual determinations of the net energy values of foods have been made, owing to the great expense of such investigations. Although most of such work has been concerned with fattening bullocks, the net energy values of less than 20 foods have been determined directly for this class of stock. (2) American investigators have been

perturbed by the wide difference in the relative values for legume hay and non-legume hay as determined by actual net-energy investigations on the one hand and by simple feeding trials on the other. Numerous feeding experiments have shown clearly that even when timothy hay is fed with supplements providing abundance of protein, minerals and vitamins, it is certainly not superior to lucerne or other legume hay. Nevertheless, in investigations by Armsby and later by Forbes, net energy values of 42·8 to 48·7 therms were found for timothy hay compared with values of only 30·0 to 36·5 therms for lucerne hay containing the same percentage of dry matter.

After referring to some of the now well-recognised limitations of the net energy system, Prof. Morrison made the somewhat surprising assertion that reliable net energy values could be determined at relatively low cost by simple practical feeding trials and then proceeded to enunciate the conditions that should be observed in such experiments. The idea was further developed in a second paper by Dr. Fraps (Ref. 47), who apparently was the first worker in the United States to utilise the results of practical feeding tests for computing the net energy values of individual feeding stuffs. The original paper should be consulted for the methods of experimentation and computation. For reasons that would require too much space to expound fully, I find myself unable to agree with the viewpoints put forward. Some of these reasons were dealt with in a third paper by Prof. Forbes (Ref. 48), who incidentally was quite scathing (perhaps too much so !) in his criticism of Kellner's method of computing starch equivalents from the data for digestible composition.

To quote Prof. Forbes : "My feeling in regard to Kellner's method of computation of the energy values of feeding stuffs is that it rests upon very slight experimental basis; that it was devised prior to the development of the main part of the revolutionary, newer knowledge of nutrition; and that it affords no scientific basis for recognizing the influences of this great body of knowledge. In my opinion, his idea of using correction factors by which to multiply computed energy values to make them agree with the results of calorimetric measurement is a hopelessly awkward and ineffective way of recognizing the individuality of feeding stuffs as determined by the intimate character and nutritive qualities of their proteins, carbohydrates and fatty constituents, their mineral nutrients and their vitamins."

It has long been my conviction that data of a basic and fundamental nature, such as net energy values and starch equivalents, cannot be established on the basis of results from practical and empirical feeding trials. A very elementary argument against the use of simple feeding tests for such a

purpose is that live-weight changes, even if they could be determined with accuracy in farm animals, cannot be used as measures of gain or loss of energy. The correct procedure for measuring both food values and food requirements is that they should first of all be established by controlled, scientific experimentation in which no part of the results is dependent on assumption or speculation. The values thus obtained should then be regarded as tentative until they have been shown to hold with a reasonable degree of consistency when tested out in practical feeding trials. It is the merit of the starch equivalent system that it does work tolerably well in feeding practice. Prof. Forbes was expressing the same kind of sentiment when he said: "As we seek true understanding, in navigating the treacherous waters of the sea of energy metabolism, let us remember that our one safe course is to be found through rigorous adherence to the method of science."

There are three further papers included in the published proceedings that should be read by all workers engaged in animal nutrition research: (1) by Prof. Mitchell on the importance of the relations between energy, protein and minerals in measuring the nutritive values of foods and rations (Ref. 49); (2) by Profs. Guilbert and G. H. Hart on the relationship of accessory factors and requirements to feed values (Ref. 50) and (3) by Prof. E. B. Hart on the guiding principles for nutrition research (Ref. 51).

Digestibility of Rations by Sheep and Cattle. In the tables showing the digestion coefficients and digestible composition of feeding stuffs, the data for ruminants are intended to apply alike to both sheep and cattle, without distinction of the one from the other and without reference to the plane of nutrition. It is generally assumed that digestion values obtained with one species of ruminant may be applied to others without material error. On account of its convenient size, the wether sheep has been the favourite animal for employment in such digestion trials.

The Pennsylvanian workers have recently submitted this hypothesis to critical examination (Ref. 52). Results are given for the average digestibility of a ration (lucerne hay *plus* concentrates) by two bullocks at six different planes of nutrition. Comparisons were also made of the digestibility of similar rations by dry cows, milking cows and sheep at various levels of feeding. Judged on the basis of the digestion coefficient of the organic matter, the digestibility of the diet in the case of the bullocks was highest (77·0 per cent.) when a maintenance ration was fed. When the ration was ½ maintenance, the digestibility was slightly lowered (76·1 per cent.), and it also fell progessively as the ration was increased beyond maintenance (75·6 per cent.

at $1\frac{1}{2}$ maintenance; 73·8 per cent. at twice maintenance and 70·4 per cent. at thrice maintenance).

In the case of the cows also, the digestibility of rations tended to fall slightly with rise in the plane of nutrition beyond maintenance, but the results from the sheep were inconclusive on this point. Sheep digested the rations somewhat more efficiently than did the cows, with the exception of the fibrous component. When the ratio of concentrate to roughage was 1 : 1, cows digested the fibre to a higher degree than sheep, but the observation was reversed when the ratio was altered to 2 : 1.

The authors conclude that the published average digestion coefficients derived from trials with sheep are on the high side for application to the full-fed cow in milk, and that there is need for separate digestion coefficients for sheep and cattle. In this relation, the influence of the plane of nutrition should also be recognised.

It is doubtful, however, whether this conclusion will receive unanimous approval. Even with two ruminants on the *same* ration, the digestion coefficients from the two animals might display wider differences than those which characterised the values for the bullocks at the different levels of feeding. Tables of feeding standards and digestible composition are at best intended only to afford guidance in the computing of rations; some small adjustment, based on the feeder's observation of the progress of his individual animals, is usually necessary and, in the very nature of things, almost inevitable when the computed ration is tested out. The results of the Pennsylvanian experiments scarcely reveal discrepancies, either as between sheep and cattle or in relation to the plane of nutrition, sufficiently marked to warrant the belief that revision of the tables on the lines suggested is a matter of extreme urgency.

Digestion of Cellulose. The Cambridge workers have continued their studies of the behaviour of cellulose-splitting bacteria in artificial media in their attempts to account for the manner in which cellulose is utilized for fat production in the body of the ruminant (Ref. 53). The behaviour of thermophilic bacteria, with an optimum temperature of fermentation in the neighbourhood of 65° C., has been compared with that of the micro-organisms capable of fermenting at body temperature (37° C.). In both cases the cultures were obtained from the rumen contents of sheep.

It was shown that, in a qualitative sense, the fermentation of cellulose takes a course similar to that for glucose. This is ascribed to the fact that glucose is one of the earliest transient phases to arise during the bacterial fermentation of cellulose *in vitro* by rumen bacteria. During this breakdown, pyruvic acid, lactic acid and lower fatty acids (formic, acetic and

butyric acids) may also arise. Propionic acid, the only recognised fat-precursor among the lower normal fatty acids, was not detected among the products of fermentation. Of the products actually identified, it is unlikely that glucose escapes further breakdown when such bacterial fermentation occurs in the rumen of the animal, and the hypothesis embodying the suggestion that the fat-forming power of cellulose might be attributable to glucose formation in the rumen has been abandoned. To what extent the fat-precursors, pyruvic and lactic acids, undergo absorption from the digestive tract during cellulose digestion is to be the subject of further investigation in work with sheep in which rumen fistulas have been established.

Susceptibility to Dietary Deficiency. There is an accumulation of clinical facts which suggest that human beings and animals vary widely in their susceptibility to the diseases of dietary deficiency. Not all the members of the crew of a scurvy-ridden ship develop the dread symptoms, nor does everyone in a famine zone become the victim of the disorders of malnutrition. No adequate quantitative data are available concerning the variations in reaction of individual animals to different dietaries.

In trials at San Francisco, young male rats were placed on a deficient diet composed of 20 per cent. casein and 80 per cent. starch-lard mixture, a ration obviously deficient in both minerals and vitamins (Ref. 54). Very great individual variations of loss of body weight occurred on this diet. Repetition of the experiment after weight-loss had been restored by a period of feeding on a normal diet showed that the rats which lost most weight in the first period of deficient feeding did so again, whilst those which suffered little in the initial period again displayed but mild suffering during the second period of the experiment. Resistance to loss of live-weight on a defective diet seems therefore to be a characteristic of the individual and not a matter of mere chance.

When rats which had lost 20 to 40 per cent. of their body weight were restored to normal by a period of feeding on an adequate ration, and were then placed again on the defective diet, the decline in weight in this second instance was found to be much more rapid than in the first period (Ref. 55). This held true in every case, even though the original rates of decline had varied considerably among the rats in the experiment. It is also noteworthy that this secondary, accelerated weight-decline was found to occur even after as long an interval as 80 days between the first and second periods on the defective diet. It is evident, therefore, that although the rats appeared perfectly normal when placed for the second time on the deficient diet, a latent defect still remained as a legacy from the first period of

deficient feeding. This condition is described by the authors as a state of "latent deficiency."

NUTRITION OF CATTLE.

Protein Supply of Dairy Cows. It is now well-recognised that the immediate consequence of dietary deficiencies in the ration of a dairy cow is not a running-off in milk yield. So strong is the primitive maternal instinct for preserving the level of milk-flow, upon which, in wild life, the welfare of the progeny depends, that for this purpose the dairy cow will contribute, from her own body reserves, all those constituents which may be lacking, or present in insufficient amount, in her dietary. Only when the using up of such body reserves has proceeded to such an extent as to endanger her health will the yield of milk show a decline. The first symptom of deficient feeding, therefore, is a running-off in condition, and only at a later date will this be followed by a fall in milk yield, the rate and extent of the fall being determined by the nature and magnitude of the dietary deficiency.

A very significant experiment in this connection has recently been made in Finland (Ref. 56). The effect has been studied of feeding rations, deficient in protein but containing a sufficiency of starch equivalent (net energy), on the milk yield of cows in the period following parturition. It was found that under these conditions the milk yield behaved normally. This was demonstrated in two ways: the milk yields of the dairy cows in the trial rose to the levels that were to be expected on the basis of the records of previous lactations; and further, increasing the protein in the protein-deficient ration did not produce a corresponding rise in milk yield. Only when the protein deficiency was very severe (*e.g.*, when the protein supply was no greater than the protein output in the milk) was a reduced yield to be noted. In such cases, of course, an increase in the food protein did lead to an increase of milk yield. The results suggested that the fat percentage of the milk is more susceptible to depression, by feeding a deficient protein supply, than the actual milk yield.

The feeding periods on the protein-deficient but energy-sufficient diets supplied to the 15 cows under test varied from about three to eight weeks after calving, and the experiments do not permit a decision to be reached as to how long the milk yield would have continued to behave normally under such conditions of feeding. It may be permitted, however, to direct attention to what seems to me to be a very significant consequence of such findings, namely, that attempts to assess the value of any food or ration, or any constituent thereof, for milk production by means of measurements of milk yields over restricted periods are quite valueless, since the vast bodily

reserves of the dairy cow are able to interpose themselves, as it were, between the ration tested and the result in terms of milk-flow, and thus effectually frustrate, over a long period, any reliable revelation of dietary deficiencies. In other words, shortcomings in the food supply may be made good by the supplementing effect of the body reserves.

Determinations of alterations of the live-weight of the dairy cows should at least form part of such experiments, since this might serve to bring to light the running-off in condition that is the earliest index of food deficiencies. Unless, however, the deficiencies were severe, live-weight determinations might constitute merely a crude and insensitive index. Better still, balance trials, accompanied by an examination of the actual character of the nitrogenous constituents of the urine, might be carried out to discover whether the dairy cow is having to break down and use up body reserves in her effort to maintain milk yield on the ration being tested. Failing this, it would be necessary to continue measurements of milk yield over a sufficiently long period to disclose either an unmistakable running-off in condition or an actual decline in milk yield before a verdict on dietary deficiencies could be pronounced. The danger is that a short-period trial, not reinforced by measurements other than those of milk yields, might lead to erroneous conclusions regarding the adequacy for milk production of any particular ration or food under test.

For a full discussion of the many aspects of the problem of the protein supply of dairy cows, the reader is referred to a recent publication from the West of Scotland Agricultural College, in which the following practical considerations are given emphasis (Ref. 57). Where strict rationing is not attempted, the dairy cow generally gets too little protein, and milk production is thereby brought below the maximum-possible efficiency. Where rationing is carried out there is a tendency, on the other hand, to feed too much protein, thus rendering the ration unnecessarily expensive. On the much-discussed question of the biological value of food protein, the author concludes that if good home-grown roughages are used in conjunction with a concentrate mixture of reasonable variety, the question of the "quality" of the protein supply becomes of minor practical significance. To balance the ordinary roughages, the concentrate mixture should as a rule contain 15 to 20 per cent. of digestible crude protein. This represents a supply of digestible crude protein of from 0·53 to 0·70 lb. per gallon of milk containing 3·7 per cent. of fat, assuming an allowance of 3½ lb. of concentrates per gallon. It is recommended that the 20 per cent. level should be adopted when foods rich in protein are relatively cheap, but that when they are dear, it would be more economical

to make up the milk-production mixture of concentrates on the basis of the 15 per cent. level.

Vetch Seed and Milk Production. One frequently receives enquiries from farmers as to the possible uses of vetch seed in the feeding of live-stock. This leguminous seed, which contains about 26 per cent. of protein, closely resemble beans in composition and apparently should be capable of replacing beans in farm rations. Little information can be derived from experience in this country, however, although I have heard of milk-production mixtures containing up to 20 per cent. of finely-ground vetch seed being used successfully. The subject has been elucidated fully in a number of investigations carried out in Germany, where every endeavour is being made to explore to the fullest extent the possibility of making the Reich independent of imported protein foods (Refs. 58, 59, 60 and 61).

It would appear that vetch seeds are not so palatable as beans. They contain an unpleasant bitter principle. Pigs are reluctant to eat rations containing them and it is reported that heavy feeding of vetch seed may even give rise to a bitter flavour in the flesh. The feeding of untreated vetch seed to dairy cows has been found to give the milk an unpleasant odour and flavour owing to the passage of the bitter principle into the secretion; but, strangely enough, after a period of such feeding, the undesirable taint disappears from the milk. In one experiment, for example, a herd of dairy cows was receiving as much as 6½ lb. of vetch seed per head per day. The milk taint and odour, which were very strong at the beginning of the feeding, gradually became weaker and disappeared after 2 to 7 weeks from the beginning of the test, the time required varying with the individual cows. It was concluded that the animal is able to develop a mechanism for eliminating or actually destroying the bitter principle. The obvious inference is that when vetch-seed meal is included in milk-production rations, it should be introduced in very small amount and increased gradually to the desired level. Such a procedure enables the animal to become accustomed to it and to set up the mechanism whereby the bitter principle no longer passes into the milk.

It was also discovered that soaking the seed in water (vetch seed takes up one-quarter of its weight of water), followed by a brisk steaming for ten minutes, would remove the bitter principle. By this treatment the bitter taste gave way to a pleasant nutty flavour. Such treated seed was as efficient as the untreated seed in respect of yield and richness of the milk from the cows under test; indeed, the animals showed a preference for the seed in this form. When the milk is intended for children, it is strongly recommended that vetch seed should be soaked and steamed, or not used at all.

One objection frequently urged against the use of vetch seed for feeding purposes is that it usually contains a minute percentage of a cyanogenetic glucoside (*i.e.*, a complex nitrogenous organic substance that may be broken down in the rumen with the formation of the highly-poisonous prussic acid). In some of the German trials, for example, it was shown that sufficient cyanogenetic glucoside was present in the vetch seed to give rise to the production during soaking of 0·05 gm. prussic acid per 1000 gm. air-dried seeds. Such prussic acid, of course, may largely be removed by the soaking and steaming procedure, but very efficient steaming is necessary to remove the last traces. The German experiments suggest, however, that little fear need be entertained on the score of possible prussic acid poisoning. Neither the untreated nor the treated seed had any disadvantageous effect on the health of the cows and, indeed, the conclusion is drawn from one set of trials that up to $3\frac{1}{3}$ lb. of untreated vetch seed (ground) may be fed per day to a dairy cow without worry.

Soya Beans and Milk Production. Great interest is being taken in the cultivation of the soya bean in Germany. "As a consequence of its high protein and oil content and its manifold applications in human and animal nutrition, the soya bean, scarcely known to us before the War, has within a short time, so to speak, conquered the world!" Such is the refreshingly unacademic opening of a scientific communication on this subject published recently in Germany (Ref. 62).

Naturally the soya bean is grown in Germany for its oil, and it is in the form of the extracted meal that the bean finds its way into farm feeding; but consignments frequently appear that for one reason or another are unmarketable. The object of this German investigation was to discover whether such seed could be utilized for feeding, as such, to dairy cows. It was found that the soya beans were well liked by dairy cows and agreed with them. A slight increase in milk yield was obtained when 35 per cent. of the concentrates for milk production was replaced by soya beans. The percentage of fat was not affected, but the butter from the milk became soft and tasted slightly of soya beans. The texture of the butter became firm again, however, when palm kernel cake was included in the mixture. When 35 per cent. of the production concentrates was replaced by extracted soya bean meal, the effect was to give rise to a hard, firm butter, and the addition of some "softening" cake, such as linseed cake, appeared to be desirable in these circumstances.

It is of interest to note that a trial on somewhat similar lines has been carried out recently at the West of Scotland Agricultural College, where it was found that a specially

prepared, unextracted soya bean meal (19·7 per cent. oil) did not differ significantly, from the standpoint of value for milk production, from ordinary extracted soya bean meal containing only 0·8 per cent. of oil (Ref. 57).

Influence of Oil on Fat Percentage of Milk. Golding and his associates have shown beyond all doubt that when small amounts of cod-liver oil are included in the diets of lactating cows, there is a subsequent decline in the percentage of fat in the milk which they secrete, and that the factor causing this decline is not recovered in the non-saponifiable fraction of the oil. Later research in America has confirmed this finding and has demonstrated that the principle responsible for this phenomenon is contained in the saponifiable fraction.

In recent work at Columbia (Ref. 63) it has been shown that when 2 oz. of herring oil was fed daily to lactating goats there was a consequent reduction in the percentage of fat in the milk, but that similar amounts of the same oil after hydrogenation had little or no effect. Hydrogenation of the herring oil destroyed, therefore, its power to reduce the fat percentage in the milk, and it is concluded that the responsible factor must be associated with the unsaturated bonds of the fishy oils. Since, however, *simple* unsaturation has been shown to produce no similar effect, the result must be due to some *particular grouping* of unsaturated bonds in the fatty acids of the oils.

Calf Rearing. An important contribution to the vexed question of "raw versus pasteurized milk" has come from the Hannah Dairy Research Institute during the period under review (Ref. 64). Two groups of bull calves from tuberculin-tested Ayrshire herds were fed up to 12 weeks of age on raw and commercially-pasteurized milk in amounts strictly in relation to their body weights. This diet was supplemented from the eighth week by hay at the rate of ⅔ lb. per head per day. No appreciable differences were noted in the skeletal growth of the two groups. Marks awarded by experienced stock judges showed consistent differences, however, in favour of the pasteurized-milk-fed group, althought the significance of such differences could not be assessed. Twenty-four of the 36 calves fed on raw milk reacted to the tuberculin test and the presence of tuberculous lesions was confirmed in 23 by post-mortem examination. One calf among the 37 in the pasteurized-milk-fed group reacted to the test, but post mortem examination failed to reveal the presence of any tuberculosis. The authors conclude that the experiments failed to show any significant differences in the nutritive values of raw and pasteurized milk, but that the use of pasteurized milk had a clear advantage in that it preserved the animals from infection through drinking milk

that had been shown to contain, in the raw state, living tubercle bacilli.

Mangolds v. *Wet Sugar-beet Pulp for Fattening Bullocks.* In trials from 1932 to 1934 at the Norfolk Agricultural Station (Ref. 65) it has been shown that wet sugar-beet pulp, both fresh and clamped, is a suitable substitute for mangolds in the rations of mature fattening bullocks. One ton of the wet pulp, with a dry matter content of 15 per cent., was found to be equivalent, in practice as in theory, to 1·9 tons of mangolds with 12 per cent. of dry matter. None of the bullocks in the experiments scoured whilst on the wet pulp, which was included in amounts varying from 60 to 90 lb. in the daily rations together with a basal ration of straw, hay and concentrates, and it is stated that the feeding of 2 oz. of feeding chalk per head per day should eliminate any danger of digestive disturbances from the use of such amounts of wet pulp. The quality of the carcasses from the pulp-fed cattle was equal to that of the bullocks receiving mangolds, a finding that affords no support to a frequently-heard criticism that pulp-fed animals " kill " badly and that their meat " eats dry."

NUTRITION OF SHEEP.

Comparatively little work of a fundamental nature appears to have been done during the period under review in the field of sheep nutrition, the publications from Cambridge and Oxford, to which reference was made in last year's *Guide*, representing the last notable contributions in this connection.

A statistical analysis of the records of a Southdown flock at Beltsville, Maryland (U.S.A.), involving the birth dâta for 829 lambs, has brought to light the following facts (Ref. 66): (1) Single lambs are heavier than twins at three months of age. (2) Lambs that are heavier at birth also tend to be heavier at three months of age. (3) Lambs born early in the season are heavier at three months than late lambs (lambing season is from late January to May). (4) Differences in weight at one year, due to birth factors, are too small to be statistically significant, the one exception, however, being the difference between single and twin female lambs. (5) Twin lambs survive equally as well as singles to three months of age. (6) Early male lambs survive better than late ones. The difference between the early and late female lambs is in the same direction, but is too small to be significant. (7) Male lambs that are heavy at birth survive better than light ones. A higher percentage of the heavy females survive also, but the difference is not significant statistically. (8) In the selection of breeding animals, single lambs are favoured over twins, early lambs over late

and lambs heavy at birth over light ones, even though no conscious effort has been made to favour any of these groups.

It is scarcely necessary to point out that these results were obtained under conditions of American animal husbandry, and that it might not be justifiable to assume that they would hold good for sheep-rearing in this country, or, indeed, even for any other breed than the one dealt with in this investigation.

Brief reference may be made to the results of another American investigation in which it was shown that, under Texas conditions, shearing sheep twice a year resulted in a slightly increased yield of wool over sheep-shearing once a year (Ref. 67). From studies of the phosphorus requirements of sheep carried out at Idaho the conclusion was drawn that a fattening lamb requires about $2\frac{1}{2}$ gm. of phosphorus daily per 100 lb. of live-weight to ensure efficient and rapid gains (Ref. 68).

Those readers who are interested in the pioneer efforts of agricultural research workers in the colonies, and the difficulties that have to be faced and surmounted, are recommended to read a recent publication dealing with attempts to improve the native sheep in Cyprus, where, of course, the sheep is kept primarily for milk, the production of lamb, mutton and wool being merely of secondary importance (Ref. 69). The reader's attention is also directed to an informative paper by Dr. Hammond, in which the author discusses the main points that should be taken into account when judging mutton and lamb carcasses for their market suitability (Ref. 70). These are divided into two sections: first, the external features, including fullness of loin, the legs and the covering of fat; second, the internal qualities that are disclosed in the cross-section obtained by cutting through at the last rib, including depth of fat over the back, size of the "eye" muscle, lightness of rib, etc., and the colour of the meat. Considerations of space forbid a detailed commentary on Dr. Hammond's expert contentions, and the reader should consult the original paper to secure the full benefit of the ideas put forward in this thought-provoking publication.

NUTRITION OF POULTRY.

Protein Supply of the Laying Hen. Experiments carried out a year or two ago in Ireland on the protein requirement of laying pullets have demonstrated that under field conditions, cereal rations supplemented by 0·5–1·0 per cent. of salt with oyster shell *ad lib.* gave as good egg production as similar rations containing varying levels of protein-rich supplements. The results suggested that it might be unnecessary, under field conditions, to include such protein foods in the rations of laying birds, and that possibly the protein requirements for

maintenance and production might actually be lower than the commonly-accepted standards (Ref. 71). Since under such field conditions, however, any deficiency of the diet in respect of protein might be made good by the consumption of protein-rich supplements such as grass, worms and so forth, it might be argued that the results of these experiments should not be used for drawing conclusions about protein requirements. Experiments under conditions of more rigid dietary control have therefore been carried out recently at the National Institute of Poultry Husbandry with the object of securing further information on this question (Ref. 72).

Nitrogen balance trials were carried out in metabolism cages on two Rhode Island Red pullets in "full lay." These were given a ration which, apart from 10 per cent. of lucerne meal, 2 per cent. of cod-liver oil, 1 per cent. of common salt with oyster shell *ad lib.*, consisted wholly of cereals and wheaten offals. The ration contained none of the protein supplements that are commonly included. The experiments demonstrated that even though the diet was considerably lower in protein than rations based on the accepted feeding standards, the nitrogen required for egg production could be drawn from the food supplied; *i.e.*, the ration supplied enough protein to maintain good egg production without loss of body protein. It was concluded that satisfactory maintenance and production can be provided by rations containing considerably less protein than is supplied in the usual commerical rations, or in rations based on the accepted standards.

Protein Supply of Fattening Fowls. The possibility of economies in feeding, by a lowering of the level of protein supply, has also been revealed in experiments carried out at Cambridge on the influence of protein in the fattening of fowls, in which it was shown that a food mixture containing 5 per cent. of dried skim milk and 95 per cent. of Sussex ground oats proved as efficient as one containing 20 per cent. of dried skim milk and 80 per cent. of Sussex ground oats (Ref. 73). Within the limits studied, the efficiency of conversion of food energy into carcass energy was not affected by variation in the protein content of the ration.

Substitutes for Sussex Ground Oats. This product has for many years been highly valued by poultry keepers and forms a part of most laying and rearing rations. The cost of grinding by the method required to produce Sussex ground oats is high, however, and in consequence they are almost invariably one of the most expensive ingredients in a mash. Experiments were begun at Hillsborough in 1933 to study the effect on egg production of using extra bran and extra maize in place of Sussex ground oats on a weight-for-weight basis, and also of replacing Sussex ground oats by the coarsely-ground cereal (Ref. 74).

That substantial economies may possibly be achieved in these directions is suggested by the results of these trials, since in every case the use of the substitutes led to a higher rate of egg production, an increased food consumption, a lowering of the feeding costs and an increased profit over the cost of the food. It was further noted that when extra maize meal was used to replace Sussex ground oats, the birds registered a greater gain in body weight.

In a further communication (Ref. 75), the author brings forward results showing the possibility of further saving in the cost of egg production by the more liberal use of grain in place of cereal meals and milling offals. The hen has been provided with its own apparatus for grinding grain, and the results of the experiments suggest that there may be very little to be gained by incurring the expense of grinding the food before feeding.

Cannibalism-preventing Properties of Oats. Cannibalism (*i.e.*, the habit of picking toes, comb, vent, feathers and other parts of the bird's body) presents a serious problem to the commercial poultryman, and many preventive measures, based on management, have been recommended. Recent American work, however, indicates that cannibalism may be the result of unsatisfied appetite caused by a deficiency of some constituent in the diet (Ref. 76).

Four trials in four different years with varying diets led to the finding that oats, fed as the sole cereal in rations for growing and laying pullets, consistently and significantly reduced cannibalism below that noted when the rations contained maize as the sole cereal. Intermediate degrees of cannibalism were observed with wheat and barley when these constituted the sole supply of cereal.

Since perosis (see section on mineral supply) was observed in the birds on the maize and barley rations, and not on the rations containing oats and wheat, and since it is now known that traces of manganese compounds in the diet are preventive of perosis, it is interesting to note that the manganese content, in mg. per 100 gm., of the different cereals was: oats, 4·66; wheat, 2·91; barley, 1·19 and maize, 0·38. The possibility thus presents itself that the relatively high manganese content may be responsible for both the perosis–preventing and cannibalism-preventing properties of oats, and further work is being undertaken to investigate this aspect of the problem. If this should prove to be the case, then a nutritional, as opposed to a management, solution of the cannibalism difficulty might open out, and it might become possible to solve the problem by including traces of manganese compounds in rations deficient in this element.

NUTRITION OF THE PIG.

The Sow and her Litter. It is often asserted that during the suckling period each member of a litter "has its own teat"; *i.e.*, suckles regularly at a particular nipple. This "suckling preference" is not without practical interest, for it would mean that some pigs in a litter would obtain very much less milk than others, since different gland sections of the udder may secrete very different quantities of milk. There has been, however, little or no information concerning the extent of this preference, although it has an obvious bearing on the variability of litter mates. An effort to fill in this gap in our knowledge has been made in work recently carried out at Edinburgh. The original publication should be consulted for a full account of the extremely informative observations made during the course of the experiments, for, as the author states, "the sow and litter provide most interesting and instructive material for the study of animal behaviour" (Ref. 77).

The author concludes that "suckling preference" in pigs arises very early in life, resulting from a desire on the part of the piglings to occupy always a particular position. Later comes recognition of a particular nipple. The original disposition is largely due to chance, but nevertheless the largest pigs will be found, in general, to be suckling the anterior nipples, for whatever their initial weight, they obtain most milk and will tend quickly to become the largest. The period in which the milk is "let down" by the sow appears to be very short, probably less than a minute. This means that the piglet must be extremely alert in taking up its favoured position if it is to secure the benefit of the milk supply.

In research work at Edinburgh with a Large White herd, an attempt is being made to isolate genetic differences in the growth rate of pigs from conception to weaning (Ref. 78). For this purpose it has been necessary to obtain direct evidence about the quantities of milk obtained by suckling pigs in order to decide whether variations in growth rate could be explained wholly on the basis of varying levels of food supply. An experiment is described in which two litters of Large White pigs were, over a period of a week, weighed individually before and after each suckling. One sow which was nursing ten piglets in her third litter gave over 30 per cent. more milk than the other which had 12 pigs in what was her first litter. A close association was found between the live-weight increases of the piglets and the amount of milk consumed. In general, the largest pigs in a litter were those obtaining most milk, but those which received the most milk in excess of their maintenance requirements appeared, nevertheless, to have converted it

into live-weight increase less economically than those pigs obtaining a smaller supply. As the interval between sucklings lengthened, the amount of milk obtained by each pig increased. It was possible, in the case of one of the sows, to ascertain the actual production from each nipple and, despite great irregularity, it was clear that the anterior nipples tended to be more productive than the posterior. In a consideration of the significance of the results, the author directs attention to the difficulties that beset the attempts of the breeder to compare the milk-producing capacities of his sows on the basis of differences in litter-weights.

In view of the diversity of opinion that exists concerning the relation between size of litter and live-weight at weaning, the results of an analysis from this standpoint of five years' records of a Large White herd at the Edinburgh Institute of Animal Genetics are of timely interest (Ref. 79). Inspection of the summarised weaning data revealed first of all that the average litter weight for gilts was below that for older sows. There was also a fairly well-defined difference in the average weight in large and small litters, but if the range of comparison were restricted to litters with seven to 11 pigs, the average weight was fairly constant for sows that had brought up one or more litters. The usual type of difficulty in generalising from the results of biological studies was encountered, since it was found that the variation in average weight was just as great for a given size of litter as it was for all the litters considered together, regardless of size. The general conclusion was drawn that litter size, in the Edinburgh herd at any rate, is a relatively unimportant, though real, source of variation in average live-weight at weaning, except perhaps where old and tried sows are concerned.

An important point from the standpoint of technique in litter-testing schemes was elucidated. A sampling experiment was carried out to determine the extent to which the post-weaning performance of a small selected sample of a litter might be expected to be representative of the whole litter. A correlation of 0·96 was found between the mean growth rate of samples consisting of the four pigs nearest the average of the litter at weaning and the mean growth rate of the whole litter. This represented a loss of only 8 per cent. of the possible information to be gained by working with the whole litter, whereas the choice of the heaviest four pigs increased the loss of information to 15 per cent.

From Cambridge comes an interesting paper dealing with fertility, mortality and growth rate in pigs, the material used in the analysis having been obtained during the years 1927–31 in the course of the operation of the East Anglian Pig-

Recording Scheme (Ref. 80). It is axiomatic that breeding stock should be selected for their capacity to produce large and healthy litters, since, unlike most other forms of live-stock, the sow is kept solely for the reproduction of her species and has no by-products to offer for human consumption. The whole cost of her upkeep must be borne by the pigs she produces.

From data based on nearly 2,000 litters, on about 20 farms, the author concludes that, on an average, the pure-bred Large White sow produces one pig more at birth than the Large White/Large Black cross. On the other hand, whilst 83 per cent. of the cross-bred pigs were alive at six weeks, only 76 per cent. of the Large Whites survived to that age. The figures support the opinion commonly held in East Anglia that the Large Black sow is a "better mother" than the Large White. In practice, however, this virtue seems largely to be discounted by the fact that the breed is less prolific.

It was further concluded that sows show no significant deterioration in size of litter, or in weight of litter at six weeks, up to the tenth litter. There appears to be little advantage in producing litters with more than 12 pigs at birth, since the addition in number is more than off-set by an increase in death-rate. The season in which the sow farrows exercises an influence on the survival rate at six weeks, approximately one pig more per litter surviving in the summer than in the winter months. Post-weaning mortality appears to be greatest in litters where the greatest variation in weight among individuals is noted at six weeks. The author emphasizes the fact that the third and fourth week of age is a critical stage in the life of the sucking pig and that special care must be exercised at this period. This finding directs attention to a further publication from Wye on the now well-known "barley water-iron" treatment for indoor-reared piglings (Ref. 81) to which reference was made in last year's *Guide*.

Before ending this section on the sow and her litter, reference should be made to an interesting attempt at Cambridge to measure the water requirements of suckling sows (Ref. 82). That the milk yield of the cow is reduced if an insufficiency of water is available is the common belief, and, by analogy, it might be expected that some of the cases of milk shortage in suckling sows should be ascribed to shortage of drinking water. Nevertheless, little, if any, attention has been paid to the problem of ascertaining the water requirements of sows with litters. When, therefore, the system of tethering sows was adopted on the Cambridge University Farm, it was decided to seize the opportunity presented of determining individual water consumption.

All the animals were of the Large White breed and only three of the 37 used were gilts. The grass did not provide a large proportion of their food and in many cases the animals ate up to 16 lb. per head per day of appropriate cubes. The work was divided into four experimental periods, two in winter and two in summer. The authors record the mean daily consumption of water for the week preceding farrowing and for the first six weeks after farrowing. The mean consumption was 43 lb. per day (1 gallon = 10 lb.), the variation between sows, and of individual sows from day to day, being very wide. The consumption was practically unaffected by weather and was nearly the same in summer as in winter, although it must be kept in mind that this is probably to be ascribed to the greater intake of grass, with its included moisture, during the summer months. It was impossible to demonstrate any relation between water consumption and number or weight of litter, but there was evidence of a slight decrease in the amount of water consumed as lactation proceeded.

The average daily water intake of the sows is summarised as follows: 43 lb. as drinking water, 5–10 lb. from the grass, 2 lb. from the concentrates and 2 lb. from the breakdown of body fat, since the sows lost considerable weight from farrowing to weaning time. The total of about 55 lb. must, according to the authors, be looked on as being subject to a fairly large possible error, especially in regard to that part of the water provided by the grass.

The Bacon Pig. Investigations have been made recently at Cambridge, by the method of balance trials, of the utilization of food protein, at different levels of protein intake, by bacon pigs throughout the period of growth from weaning to slaughter (Ref. 83). The feeding treatments are referred to as the "normal-protein" and the "high-protein" diets, the former containing the amounts of white-fish meal customarily used in pig-feeding, whilst the latter were derived from the normal-protein rations by the replacement of 12 per cent. of barley meal by an equal weight of extracted soya bean meal. The main conclusions are as follows:

The young pigs after weaning were able to digest their food with as high an efficiency as was displayed in the later stages of growth. The extra protein in the high-protein rations had little or no effect on the extent to which the food was digested. The gilts showed a consistently higher rate of nitrogen retention (*i.e.*, protein storage) than their brother hogs. This behaviour was manifested even when the protein supply in the rations of the gilts was lower than that in the rations of the hogs with which they were compared. This more efficient utilisation of

food protein by the gilts is held to explain the tendency of gilts to give somewhat leaner carcasses than hogs (Ref. 84).

Nitrogen retention from the high-protein diet was no higher than from the normal protein rations, a finding which points to the conclusion that the amount of protein in the normal rations was sufficient to meet the demands for quick growth required by modern standards of pig production. A very large proportion of the extra protein in the high-protein diet could be accounted for by the extra urea eliminated in the urine of the pigs on these rations; that is to say, the nitrogen in such extra protein was not utilized for the production of flesh protein but was lost from the body in the form of urea. This finding affords a scientific basis for explaining why an increase of the protein supply beyond the levels ordinarily fed in practice leads to no gain in respect of carcass leanness (Ref. 84).

The daily retention of nitrogen remained very much the same throughout the whole period from weaning to slaughter at 200 lb. live-weight. Indeed, the results suggest that the requirements of the bacon pig for protein, lime and phosphoric acid do not fall off during the whole period, and that the pig at 200 lb. is still to be regarded as an immature and quickly-growing animal with a high requirement for such constructive materials as protein and minerals. The demands for chlorine from the food, however, appear to be small, and rations ordinarily used in good feeding practice are capable of supplying the animal's requirements for this constituent.

The results of palatability tests on the "green" bacon suggest that the retention of 5 per cent. of white fish meal in the ration right up to slaughter may be attended with the risk of production of slight fishy taint. Safety lies in discontinuing the use of this feeding product during the final month of feeding (Ref. 85).

The question of the respective merits of unrestricted dry feeding and controlled wet feeding, particularly in regard to rate of growth and grading returns, is of particular interest to the practical man. Experiments were commenced at Hillsborough some two or three years ago to collect data on this point (Ref. 86). In the dry-fed groups, the dry feeders were filled up when necessary and left open all the time, so that the pigs could eat as much as they wished. In the wet-fed groups, the damped meal was restricted to such amounts as could be consumed readily in 10–15 minutes.

The groups given the unrestricted dry-feeding showed generally higher live-weight increases than the comparable group on the controlled wet feeding. The dry-fed groups, however, consumed more meal per pig per day and more meal

per lb. live-weight increase. The accompanying figures represent the averages for all the pigs in the experiment.

	Controlled wet feeding lb.	Unrestricted dry feeding lb.
Average L.W.I. per pig per day	1·32	1·51
,, meal consumption per pig per day ..	4·70	5·71
,, ,, ,, per lb. L.W.I. ..	3·56	3·78

The authors are of the opinion that the waste of meal from the dry feeders accounted for part of the extra meal required per lb. live-weight increase in the dry-fed group. The pigs that received the food as a slop, and in controlled amount, graded significantly better than the pigs on unrestricted dry-feeding.

This year we have the advantage of two fully-considered reports from Mr. Mansfield and Dr. Crowther respectively on the much-discussed question of the restricted feeding of bacon pigs. The experiments at Cambridge (Ref. 87) were carried out by the method of individual-feeding, restriction of food allow ances beginning at 65 lb. live-weight. The following main conclusions were drawn: Restricted feeding gives a carcass with a thinner back fat without having any ill-effect on the thickness of the belly. It appears to lead to an improved efficiency of food conversion, since although the restricted pigs were, on an average, 35 days older at slaughter than the unrestricted animals, they had actually consumed on an average 33 lb. less food per head during the growth and fattening period. Although the optimum degree of restriction must in some measure be dependent on the time of the year and the type of pig being fed, it would appear to be, according to the Cambridge report, in the neighbourhood of 25 per cent. of the amount that the pig would consume if given as much as it would eat. A warning is given, however, that if restriction is carried too far, the rate of live-weight increase will be reduced to such a level that there will be a risk of the production of soft fat, since slow growth tends to give a softer fat than is produced in quick growth.

At the Harper Adams College three separate restriction experiments have so far been carried out (Ref. 88). In these trials a total of 74 pigs in all have been "full-fed" and 112 pigs have been subjected to restriction of food supply in varying degrees and imposed at various stages of the pig's growth. The animals in all cases have been housed and fed in groups of five (reduced in some cases to three or four), so that the food consumption data are based upon these groups and not upon individual rationing. Dr. Crowther reports that in the first experiment there appeared to be some advantage in restriction as shown by efficiency of food utilization, quality grading and financial returns; but no such advantage appears in the results

of the second and third experiments, except possibly a small advantage in the food : gain ratio and, in the third experiment, a small financial advantage. It should be pointed out that the grading of the carcasses in the first experiments was carried out according to the provisions of the 1936 Contract, whereas in the later experiments the undoubtedly more lenient standard of the 1937 Contract was used.

The final conclusion should be noted by all pig-breeders who may be interested in the merits and drawbacks of the system of restricted feeding. To quote Dr. Crowther : "So far, therefore, except for the imposition of a maximum daily food-supply in the region of 6 lb. per head, our experiments have not yet provided any substantial justification for any radical change in our normal (and simple) 'full-feeding' method."

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SOILS AND FERTILIZERS.

GENERAL.

In spite of great efforts on the part of all concerned, the agricultural situation remains unsatisfactory. Since 1919 the area of arable land in England and Wales has fallen by 3·2 million acres, while grassland has increased only by 1·3 million acres: the total loss of agricultural land has, therefore, been 1·9 million acres. Since 1914 the loss has been even greater, amounting to 2·3 million acres. The growth of the towns is responsible for only about 20 per cent. of this loss: most of it represents simply reversion to rough grazing. The figures are given in Table 1.

TABLE 1.

Land Utilisation.

England and Wales : thousand acres.

——	1914.	1919.	1936.	Loss or gain between 1919 and 1936.
Arable land	10,998	12,309	9,120	3,189 loss
Grassland	16,115	14,439	15,743	1,304 gain
Total cultivated area ..	27,113	26,748	24,863	1,889 loss
Rough grazings	3,782	4,121	5,433	1,312 gain
Forest	1,884	1,884 (*a*)	2,000 (*b*)	116 gain
Other purposes (towns, villages, roads, etc.) ..	4,357	4,383	4,837	454 gain
Total land area	37,136	37,135	37,133	

(*a*) 1924 Census.
(*b*) 3,200 thousands for Great Britain, an increase of 200 thousands since 1924.

Concurrently there has been a fall in the numbers of workers on the land. From 1921 to 1936 the fall has amounted to nearly a quarter of a million, all told, for England and Wales :—

—	Regular men and boys (thousands).	Total workers, including women and casuals (thousands).
1921	612	869
1936	502	641
Fall	110	228

Only about 40 per cent. of our food is produced at home, the proportion varying, however, for the different foods. The proportions of home production and importation of the different foods in the United Kingdom are given in Table 2.

TABLE 2.

Percentages of food home-produced and imported. United Kingdom.

—	Home-produced. 1935.	Imported.	
		1935.	1936.(*a*)
Butter	10	90	91
Wheat	26	74	77
Cheese	30	70	71
Sugar	30	70	52
Meat : Beef and Veal	52	48	48
Mutton and lamb	43	57	56
Pork and bacon	50	50	48
Eggs	66	34	38
Poultry (*b*)	76	24	25
Potatoes	96	4	6
Liquid milk	100	—	—

(*a*) Figures kindly furnished by the Ministry of Agriculture.
(*b*) Great Britain.

It is not safe to count on a continuation of importations of the kind that we have had hitherto. Much of our imported food was produced under conditions of prairie farming and ranching, which are now passing. A new farming will no doubt arise in these countries, but neither quantities nor prices of the products can be foretold, and the wisest policy is undoubtedly to do as much as we can towards feeding ourselves.

For a good deal of the home production the farmer is dependent on materials such as fertilizers and feeding stuffs supplied from outside.

In face of this shrinking area of land and the diminishing number of workers, how is the farmer to maintain and, if possible, to increase his output of food? Even more important, what can be done to stop the shrinkage?

There are various possible remedies, social, economic and technical, but the line adopted at the experimental stations is to seek means whereby the efficiency of the farmer and of the worker can be increased so that they may, with the same expenditure of time and energy, produce more food. Thus can higher wages be afforded for the worker and a better standard of life for the countryman. Greater efficiency turns, in the end, on greater knowledge of the materials, and of the conditions necessary for their most successful use. It is this knowledge that experimental stations try to obtain.

A redeeming feature of what would otherwise be an entirely depresssing situation is that the value of the agricultural output is well maintained in spite of the smaller numbers of acres and of men: calculated on the pre-war price basis the value of the output was £141·7 millions in 1925 for 803 thousand workers, and £170·7 millions in 1936 for 641 thousand workers. These are gross values, not net values, but nevertheless they indicate an increasing efficiency of production. But these figures give no ground for complacency: there still remains the vital need for increasing still further the output and efficiency of the worker: only in this way can an economic basis be found for measures to stop the drift to the town.

Several methods are being tried to overcome the difficulty of the shortage of labour on the farm: this subject is outside my province, but reference must be made to one of the methods because of its effect on the productiveness of the soil. Numerous attempts are being made to settle some of the unemployed on the land: some of the most important are by the Land Settlement Association, the Society of Friends, and the Carnegie Trustees, the last body having allocated the sum of £150,000 for experiments in this subject over the period 1936-1940: in the 1937 Report (Ref. 1), Land Settlement is rightly described as "one of the most intractable of social problems, and to find the right answer to its many difficulties calls for patient research spread over a number of years." The experiments include whole-time holdings, part-time holdings, and cottage homesteads: the new homes are set up in favourable circumstances and at considerable cost, but a substantial proportion of the people could not stay and had to be returned to their own houses. The settlements are widely scattered in the industrial areas and also in Bedfordshire and Suffolk.

The County of Glamorgan is interesting as one of the districts where experiments on social amelioration are being undertaken;

the settlements there are of several types, including ordinary small holdings, subsistence small holdings, training farms, and a Co-operative Settlement at Boverton Castle, under which the workers, after drawing their statutory wages and paying other outgoings, divide the profits among themselves. The first Annual Report has been published and the balance sheet seems satisfactory (Ref. 2).

It is much too early to say whether any of the schemes will succeed: from the countryman's point of view, the loss of productivity from the land has to be taken into account, the new occupiers being much less competent than the ordinary country workers. The schemes must be judged on their social merits, not on food production grounds.

Home Grown Feeding Stuffs.

The requirements of human food for the country are well known, but there is less information about the requirements of animal food. N. C. Wright (Ref. 3) has recently collected the available data which are set out in Table 3. These estimates of available quantities closely agree with independent estimates of food requirements by the live-stock population.

Table 3.

Approximate quantities of feeding stuffs available in the United Kingdom, 1935.

Thousands of tons.

—	Protein equivalent.	Starch equivalent.	Total weight.
Home-produced.			
From Arable land	1,165	7,473	14,571
From Permanent grass	1,348	8,910	18,163
By-products	77	154	275
Total home production	2,590	16,537	33,009
Imported.			
Cereals and cereal products	526	3,672	6,013
Oil seed products	341	989	1,735
Total imported	867	4,661	7,748
Total supplies	3,457	21,198	40,757
Proportion home-produced	72%	80%	81%

According to these estimates we produce 72 per cent. of the protein equivalent and 80 per cent. of the starch equivalent

required by the live-stock of the country. Of the home production some 60 per cent. is from grass and 40 per cent. from arable, which is remarkably close to the relative areas of permanent grass and arable land in the United Kingdom (60 grass : 43 arable). The Table also shows how great a contribution the arable land makes to our food supply, since it not only provides its full share of animal food but also a large part of our output of human food.

In order to increase the proportion of home-grown feeding stuffs it is obviously important to improve the output both of grass and arable land. One of the surest ways of doing this is by a better use of fertilizers.

Fertilizer Consumption.

The use of fertilizers continues to increase, and the world consumption last year reached the enormous figure of 41 million tons. The best estimate is that of Mr. A. N. Gray (Ref. 4), the leading expert on this subject, given in Table 4.

Table 4.

World consumption of fertilizers.

Million metric tons.

Nitrogenous fertilizers	11·65
Phosphatic ,, ...	22·85
Potassic ,, ...	6·46
Total	40·96

The world agricultural consumption of nitrogenous fertilizers again reached a record amounting to 2·34 million metric tons of pure nitrogen and corresponding to nearly 12 million tons of sulphate of ammonia. The only nitrogenous fertilizer the use of which has fallen off is Chile nitrate of soda, the consumption of which has fallen nearly 40 per cent. since 1927-28. On the other hand the consumption of synthetic nitrogen is now 3½ times what it was then.

There has been a remarkable change in popularity of the different nitrogenous fertilizers. Sulphate of ammonia is now by far the most commonly used, accounting for about one half of the total consumption of nitrogen. The others are used in much smaller quantities, cyanamide and nitrate of soda, which are next in favour, each amounting to about 13 per cent. only.

Great Britain is one of the greatest producers of nitrogenous fertilizers, and there is a large export trade. The figures are given in Table 5.

TABLE 5.

Great Britain and Ireland and the Channel Islands.

(*Tons of* 2,240 *lb.*)

Fertilizer Year (*a*).	Agricultural Consumption of Chile Nitrate (*b*).	Agricultural Consumption of Sulphate of Ammonia (Total)	Total Production of Sulphate of Ammonia as such.	Exports of Sulphate of Ammonia from British Isles and Ireland (*c*).
1913–14 (*d*) ..	80,000	60,000(*b*)	364,500	323,444
1927–28 (*d*) ..	37,000	169,900	475,000	302,596
1936–37 (*e*) ..	36,000	226,000	478,000	243,973

(*a*) For the period 1913/4–1927/8, years ended 31st May. From 1928/29 onwards, years ended 30th June.

(*b*) Estimated.

(*c*) Other than to or from the Channel Islands.

(*d*) Twelve months ending May 31st.

(*e*) Twelve months ending June 30th.

The export is now largely to India and Ceylon, the West Indies, British Guiana and Mauritius, China and Hong Kong, Australasia, Malaya, Spain (much reduced by the war), Portugal and the Canaries.

The output of superphosphate in Great Britain continues to expand, and was in 1936 (the latest year for which figures are published) higher than for many years past. The home consumption is not yet all met by home manufacture and there is still a net importation which, however, is nothing like as great as it was in the period 1930 to 1932. The figures are given in Table 6.

TABLE 6.

Production and Consumption of Superphosphate in Great Britain and Ireland.

Thousand metric tons per annum.

—	Average Consumption.	Made in Great Britain.	Export.	Import.
1930–34	608·5	529·3	9·7	89·7
1935	612·1	573·6	17·7	46·1
1936	601·2	587·4	17·4	32·9

The basic slag statistics show a marked improvement in the quality of slag used in recent years. Since 1926 the total consumption has increased by 41,000 tons and in 1937 attained the record figure of 301,365 tons but the increase has been

entirely in the high-soluble slag, and very largely in the slags rich in phosphate. The consumption of low-soluble slag has considerably fallen off. (Table 7.)

In addition, some 30,000 to 40,000 tons of ground mineral phosphate are used annually as fertilizer in Great Britain, as well as a substantial amount that goes into compounds. Also, some 40,000 to 45,000 tons of bone fertilizers are used here—mostly home produced, though there is some importation of bones. Superphosphate accounts for about 70 per cent. of the world consumption of phosphate, and basic slag for about 22 per cent.

TABLE 7 (Ref. 5).

Deliveries of Ground Slag by Basic Slag Firms in Great Britain. (The figures are based on returns kindly supplied by Basic Slag firms in Great Britain). Classified according to Phosphoric Acid Content and Citric Solubility.

Season.	8% to 11% P_2O_5.		12% to 15% P_2O_5.		$15\frac{3}{4}$% to $18\frac{1}{2}$% P_2O_5 (*a*).		Total deliveries in the season
	80% Citric solubility.	Less than 80% Citric solubility.	80% Citric solubility.	Less than 80% Citric solubility.	80% Citric solubility.	Less than 80% Citric solubility.	
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1926	57,812	40,563	66,230	50,406	44,653 (7,644)	1,494 (50)	261,158
1928 (*b*) ..	39,839	11,664	48,325	41,550	16,480 (4,049)	781 (90)	158,640
1936	80,480	24,080	82,062	40,238	26,038	13,562	286,460
1937	74,687	14,343	78,385	31,864	92,657	9,429	301,365
Change since 1926 ..	+16,875	−26,220	+12,155	−18,542	+48,024	+7,935	+41,207

(*a*) The figures in brackets in these columns show the quantities of slag of $18\frac{1}{2}$% P_2O_5 content included in the totals. They are shown thus because, for the most part, slag of $18\frac{1}{2}$% P_2O_5 content is of foreign origin.

(*b*) It has been possible for the years 1928/29 to 1932/33 and 1935/36 to show separately British and foreign slag. In 1933/34 deliveries of foreign slag amounted to 41 tons, while in 1934/35 no deliveries of foreign slag were returned.

Separate figures are no longer available for the consumption of potassic fertilizers in Great Britain, though, as there is no production in this country, an estimate can be derived from the Board of Trade returns showing the amount of imports; these figures indicate a consumption of 70,000 tons of potash (K_2O) in Great Britain and Ireland as against 42,000 tons ten years ago, a steady and continual increase. About one quarter of the potash is used in the form of sulphate, about 40 per cent. as muriate and the rest as potash salts.

Mr. Gray (Ref. 4) has got out some remarkably interesting figures showing the consumption of fertilizers in the different countries of Europe. Holland is by far the heaviest consumer

in proportion to its size: the figures for 1936, for a few of the countries are, in pounds total of nitrogen, potassium and phosphorus, per acre of arable land:—

Holland	243	Denmark	46
Belgium	132	Great Britain	45
Germany	98	France	32
Switzerland	57	Italy	25

There are remarkable differences in the proportions of the different fertilizers used in different countries as is shown in Table 8.

TABLE 8.

Proportions of plant foods used in different countries.

—	Nitrogen (N).	Phosphoric acid (P_2O_5).	Potash (K_2O).
Holland	100	150	150
Germany	100	130	200
Great Britain	100	280	120
France	100	270	150
Italy	100	280	14
Sweden	100	200	120
Denmark	100	185	100

It is not possible to explain fully the reasons for these different choices, but the general similarity between the Dutch and the German, the British and French, and the Danish and Swedish figures is striking. Whether the low consumption of potash in Italy is the result of soil, climatic or economic factors would make an interesting enquiry.

MINOR ELEMENTS IN PLANT NUTRITION.

In the *Farmer's Guide* for 1935 a summary of this subject was given but a good deal of work has been done in the last two years.

Boron.—Since Dr. K. Warington in 1923 clearly showed that certain plants need small quantities of boron for proper growth, agriculturists all over the world have been looking for cases of boron deficiency. Two summaries of the rather scattered observations have recently been published; one by A. W. Greenhill (Ref. 6) giving good illustrations of the diseases caused in apples, cauliflower (Ref. 7), celery, sugar beet and turnips when supplies of boron are inadequate: the other by R. W. G. Dennis (Ref. 8) giving a detailed account of the effects on general agricultural crops. The effects of boron deficiency on carrots are being studied at Rothamsted by W. E. Brenchley. Experiments of this latter type enable the symptoms of the

deficiency disease to be so fully described that experts can recognise it when they meet it in the field, and as the knowledge spreads so the reported cases increase in number. Whether there is any actual increase in the amount of the disease is not clear, though an explanation could be forthcoming if there were : the replacement of Chilean nitrate by pure sulphate of ammonia as a fertilizer may have something to do with the case, for the commercial nitrate has been shown to contain enough boron to supply the needs of the plant (Ref. 9). Indeed the distinguished French chemist, G. Bertrand (Ref. 10), thinks it not unlikely that several of these "deficiency" troubles arise from the fact that modern artificial fertilizers have been so highly purified that most of the beneficial impurities formerly present in the old fertilizers have been removed.

This whole question of boron requirements of crops, however, needs proper systematic investigation. A good deal of desultory work is going on, but it is very desirable that the subject should be thoroughly studied by some competent body of agricultural scientists adequately equipped for the purpose. Much more still remains to be discovered.

Copper.—An account was given in an earlier *Guide* of the remarkable effects of small dressings of copper sulphate on certain reclaimed low-lying moorland soils. Good work on the subject is being done at the Wageningen Agricultural College, in Holland, where striking effects of copper deficiency are shown. Professor B. Sjollema (Ref. 11) of the University of Utrecht states that animals fed on the hay from these soils develop a "licking disease," which he attributes to the need for finding the missing copper: they recover when small quantities of copper sulphate are fed to them.

Zinc.—The Rosette disease of fruit trees has for some time been attributed to a deficiency of zinc but recent Californian experiments (Ref. 12) suggest that something more is involved : some soil biological factor seems also to be at work. The disease did not appear after the zinc-deficient soil has been sterilised or even partially sterilised, but it set in when a small quantity of unsterilised soil was added. It could be cured, however, by suitable additions of zinc sulphate.

Molybdenum.—Miss F. M. L. Sheffield of Rothamsted showed some time ago that small quantities of molybdenum compounds produce remarkable effects on plant growth, including changes in habit of growth and also in the appearance of the leaf, making the plants look as if they had got virus disease. It is now suggested that some plants naturally contain enough molybdenum to injure animals feeding upon them. The herbage of much of the Lower Lias pasture land of Somerset causes severe scouring

in dairy cattle, and to a less extent in sheep, and hence is of little use for summer grazing: it is called "teart" land. The trouble has been known for a long time, but no cause could be discovered. Analysis of the herbage shows, however, that the "teart" herbage contains molybdenum while the healthy herbage does not (Ref. 13). The symptoms of the disease were produced when healthy animals were given quantities of molybdenum equivalent to what they would have taken had they been fed on "teart" herbage. It will be extremely interesting if this observation is confirmed.

Cobalt.—"Bush sickness" of sheep and cattle in New Zealand is now attributed to deficiency of cobalt in the herbage, and this, of course, is a direct consequence of deficiency of cobalt in the soil. Miss E. B. Kidson (Ref. 14) who has been studying this problem at Rothamsted, has obtained evidence that the cobalt content of the soil is in general related to its magnesium content: serpentine, which is rich in magnesium, gives rise to soils of high cobalt content, while granite produces soils of low cobalt content. Soils from Dartmoor, on which sheep suffer from "pining" disease, contained only 3 to 4 parts per million of cobalt, while healthy soils contain 11 to 30 parts per million.

Manganese.—Work on manganese deficiency has been continued at Rothamsted chiefly with the purpose of estimating the availability of the manganese in the soil so as to be able to forecast the possibility of manganese deficiency diseases—Grey Speck disease in oats, Speckled Yellow in sugar beet and Marsh Spot in peas. Soils on which these diseases have been found have usually been of the same general type, namely reclaimed peats rich in organic matter and made alkaline by lime. Marsh Spot in the Romney Marsh area does not occur on acid soils, which would naturally contain more soluble manganese than the alkaline ones. A few of the alkaline soils, however, gave healthy peas, and it was not possible to distinguish these by analysis from the others which gave diseased peas.

Organic Substances Promoting Plant Growth.

(a) *Auxins.*—Certain chemical substances have the property of stimulating plant growth, especially root formation: they are called by the general name auxins. Chemists can now produce auxins on a commercial scale, and their effects on plants have been extensively studied at the Boyce Thompson Institute, near New York, and at the Wisley Experimental Station by Dr. M. A. H. Tincker. So far the value of these substances seems to be to the horticulturist who is seeking to strike cuttings of plants that root with some (but not extreme) difficulty; roots will even develop from leaves. The auxins are complex

acetic acids (indolyl-acetic, naphthalene-acetic, phenyl-acetic, etc.) and 1 part dissolved in 20,000 to 40,000 parts water is usually effective (Ref. 15). There still remain many difficulties to be overcome, and the method is not yet suitable for general practical application.

(b) *Soluble humus substances.*—For the past ten years investigations have been made at the University of Posen, Poland, by Professor B. Niklewski and his colleagues, on the influence of soluble humus substances on plant growth. The first papers dealt with plant physiological problems and showed that peat and other kinds of humus yield, on treatment with reagents, substances which stimulate root growth: the recent papers (Ref. 16) deal with the agricultural chemical problems, especially with the effects of water extracts of farmyard manure. In both water and sand cultures these extracts greatly increased the development of roots, shoots and leaves, and improved the colour of the leaves. The explanation put forward is that something present in the extract increases the permeability of the protoplasm of the root cells to the nutrient salts, and so enables the plant to take up its food more easily. Good samples of farmyard manure may contain 1·2 to 5 per cent. of these substances (reckoned on the dry matter). Unfortunately the stimulating substance retains its activity only for a short time and quickly goes out of action in the soil, especially when much calcium ion is present—as in most fertile soils. How far the effect comes into play in practice remains to be seen.

Farmyard Manure.

Farmyard manure must always remain the basis of manuring and in a recent summary (Ref. 17) it is pointed out that the direct effect of 10 tons of farmyard manure is usually about equivalent to that of 2 cwt. sulphate of ammonia. Calculated on a nitrogen basis one part of ammoniacal nitrogen is about equal to three or four parts of nitrogen in farmyard manure in the year of application. At Rothamsted the responses of potatoes to farmyard manure varied from 1·1 to 3·2 tons per acre, but the average over all the experiments at Rothamsted and other centres for a dressing of 15 tons of manure was 2·1 tons per acre. In the continuous wheat and barley experiments one part of nitrate of soda nitrogen had about the same value as four parts of farmyard-manure nitrogen in the year of application; a similar proportion was obtained for kale at Woburn.

The residual effects, indeed, are much more important for farmyard manure than for sulphate of ammonia or nitrate of soda, but it is very difficult to give a figure showing their value. In the experiment on Little Hoos field, continued for 22 years on crops grown in rotation, the dung made by cattle having a

good cake ration was considerably more effective in its first year than dung made by animals on a store ration, but in the subsequent three seasons the effects of the two types of manure were very similar. The residual effects of dung of any kind were much more pronounced than those of commercial organic manures such as shoddy, guano and rape cake; but in the fourth season after application the residues of dung increased production only by some 20 per cent. above the level of the continuously unmanured plot.

An experiment of a better kind is now being carried out in order to compare the residual effects of dung with those of Adco compost and of straw ploughed into the soil in combination with supplementary artificials.

In another experiment 10—15 tons dung applied to potatoes or kale increased the succeeding cereal crops by 2·2 to 3·6 cwt. grain per acre in every case: *i.e.* the dung residue produced the same effect as one cwt. sulphate of ammonia applied direct, making the total effect of 10 tons of dung, direct and residual, about equal to that of 3 cwt. sulphate of ammonia; one part sulphate of ammonia nitrogen is then about equal to three parts of farmyard manure nitrogen. In an experiment in which dung was applied to barley, clover sown under the barley continued to benefit from the dung for at least three seasons, the green weights being doubled by the dung in the first season.

Remarkable results were obtained where farmyard manure was used year after year for a long period. One of the plots on Hoos field, on which barley has been grown continuously since 1852, received farmyard manure every year from 1852–1871 but has received no manure of any kind since; it still gives higher yields than the plot which has been continuously unmanured since 1852. Results for the last three years are given in Table 9.

TABLE 9.

Barley, cwt. per acre.

Plot	—	1935		1936		1937	
		Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
6–1	Unmanured since 1852	11·0	18·4	7·5	11·9	1·8	5·2
7–1	14 tons dung 1852–71, then unmanured ..	20·0	23·7	12·8	18·9	3·6	13·3
7–2	14 tons dung annually since 1852	33·9	59·3	28·1	42·2	15·2	31·7

Similar results appeared on Hoos field when the permanent potato plots, which for 26 years (1876–1901) had received annual

dressings of 14 tons of farmyard manure, were discontinued and cropped with cereals without further manure. Much depends, of course, on the way the farmyard manure is made. Hesse (Ref. 18) has recently published an account of some modern German methods.

Method of applying farmyard manure.—Previous Rothamsted experiments have shown that it makes little difference whether farmyard manure applied to potatoes is ploughed in in spring or in autumn, but present experiments show that application of the manure in the "bouts" is better than ploughing in either in December or January. Results for the past three years are given in Table 10.

TABLE 10.

Potatoes : tons per acre.

Farmyard Manure (15 *tons per acre*).

——	No Dung.	Ploughed in.	In the bouts.	Mean response.
1935	5·24	7·15	8·06	+2·36
1936	5·21	6·45	8·33	+2·18
1937	6·16	7·64	9·60	+2·46

Effects of dung on the responses to artificials.—The question whether artificials may be profitably applied on land which is also being dunged has been studied in several experiments.

With potatoes the responses to sulphate of ammonia were increased in the presence of dung in seven out of eight experiments, presumably due to the minerals contained in the dung.

The responses to muriate of potash were decreased by the addition of dung in four experiments out of five, while at Rothamsted in 1937 the response to superphosphate was decreased in presence of dung, though not significantly.

With sugar beet (roots) the responses to sulphate of ammonia were not significantly affected by the addition of dung in any of the three experiments in which sulphate of ammonia produced a clear response. The responses to muriate of potash were somewhat decreased by dung in two experiments; in the third, potash produced small but not significant depressions in yield both in the presence and the absence of dung. In other experiments the responses to superphosphate and potash salts were slightly decreased by the addition of dung.

With kale, the responses to sulphate of ammonia were in both experiments smaller in presence of dung, though not significantly so.

Organic Manures.

The Ministry of Agriculture statistics show that the production of cereal straw in England and Wales is $1\frac{1}{2}$ million tons less now that it was in 1913, which means that probably some 4 or 5 million tons less farmyard manure is being produced and used annually now than before the war. The winter feeding of bullocks in yards is also less common. This growing shortage of stable manure has seriously curtailed the supply of organic manure for the soil, and alternative sources are being studied. More and more there is a tendency to divert waste products to other purposes; but certain products, particularly sewage sludge and town refuse, still offer some possibilities. The manurial value of town refuse treated by a new process is being tested.

Experiments with Brussels sprouts made by A. H. Lewis (Ref. 19) at Datchet showed that the organic manures, crushed hoof, meat-and-bone meal, shoddy, fish meal, soot, dried blood and Peruvian guano supplied no more nitrogen to the crop, and gave no more dry matter per acre, than the corresponding dressings of sulphate of ammonia, particularly if the lime supply in the soil was adequate. The Tables show, however, that the yield of marketable sprouts was greater with some of the organic manures than with artificial fertilizers, a result also obtained at Rothamsted with poultry manure. This question needs further study.

The supply of lime is complicated by the fact that some fertilizers use up lime at a greater rate than others: this has been further investigated by Lewis (Ref. 20).

Peruvian guano.—Few experiments have been made with this substance since the Little Hoos field experiments at Rothamsted were discontinued. An experiment on modern lines made on hops in Herefordshire showed that the standard inorganic fertilizers gave better yields than Peruvian guanos made up to supply the same amount of plant food:—

	Cwt. dried hops per acre.
Control	12·1
Organic: Peruvian Guano	15·9
Standard inorganic fertilizers	18·0

There was no difference in quality between the hops grown on organic and those on inorganic fertilizers (Ref. 21).

Poultry manure.—The experiments on poultry manure carried out under the aegis of a Committee of the Ministry of Agriculture were continued in 1937 (Ref. 22). The manure for the 1933–36 experiments had been obtained from Suffolk, but for the 1937 experiments the supply was from Hampshire:

the percentage of nitrogen, phosphoric acid and potash were very similar :—

—	Percentage in dried manure.				
	Nitrogen.	P_2O_5.	K_2O.	Total Ash.	Dry matter.
1936 Suffolk	3·90	3·53	1·70	35·3	88·7
1937 Hampshire ..	3·75	3·43	1·76	22·2	85·1

In the first three years the poultry manure was distinctly inferior to sulphate of ammonia. Its direct effect, based on 29 experiments, amounted to only 64 per cent. of that of sulphate of ammonia. In 1936 the figure was 71 per cent. as the mean of 14 experiments; 8 cwt. dried poultry manure had thus about the same value as 1 cwt. sulphate of ammonia.

Poultry manure leaves some residue, though not very much, in the soil. If one goes on using poultry manure on the same ground, it usually compares more favourably with sulphate of ammonia in the second than in the first year.

Composts.

There is still discussion about the making of composts, and their chief advocate, Sir A. Howard (Ref. 23), has again set out his views that composts made by the so-called Indore process (where the feeding of the micro-organisms is done by adding dung and young or soft vegetable matter instead of chemicals, and where, therefore, artificial watering is less necessary than for the " Adco " process) give crops and produce of better quality, freer from insect pests and fungus diseases than those produced in the ordinary way; further, that human beings and animals fed on these crops are also freer from disease. So far as this country is concerned, however, the actual position still remains much as it was. Composts can be made if the necessary conditions for the activity of the micro-organisms are ensured; and these conditions have been shown by Hutchinson and Richards (Ref. 24), at Rothamsted, to be food supply, air supply, moisture, temperature and freedom from acidity. The necessary micro-organisms are always present and under proper conditions multiply to the necessary extent: there is no need to add them to the heap. In general, it is necessary to add both food and water, and in this country the main difficulty of compost-making is the supply of these two things. The food can be given in the form of artificial fertilizers, animal excretions, young plant material, etc., while the water usually has to be pumped on: both food and water involve expense. Some turning may be necessary to ensure proper mixing and decomposition, and this

again adds to the cost. The result is that compost-making is so expensive in this country that it is not done on farms, though it is carried out in many private and market gardens and by growers under glass. The usual process is the Adco one, or some modification of it. A good account of the details has been published (Ref. 25), and the special problem of autumn leaves in the garden has been discussed (Ref. 26). In France a modified method is successfully used for making, from straw, a compost suitable for mushroom growing, now that horse manure from the cavalry stables is no longer obtainable in sufficient quantity. (Ref. 27).

A few experiments on the subject have been made in England. One, conducted at the Lady Manners School, Bakewell, in association with the Rothamsted staff, was commenced in 1932 and has been continued each year since; it is designed to test the effect of a dressing of 8 tons of compost, mainly from grass mowings, in comparison with a dressing of artificials consisting of 2 cwt. nitrate of soda, 3 cwt. superphosphate and 1 cwt. 30 per cent. potash salts per acre. Some of the plots receive their manure only in 1932 and alternate years, others only in 1933 and alternate years, while a third set are manured every year.

TABLE 11.

Meadow Hay—Immediate Effects of Artificials and Compost.

(Cwt. per acre.)

—	Mean Yield.	No manure in previous year. Response to		Manured in previous year. Response to	
		Artificials.	Compost.	Artificials.	Compost.
1933	39·5	+19·2	+16·4	+21·0	+9·4
1934	43·1	+8·5	+4·5	−0·3	−2·4
1935	44·3	+18·9	+14·2	+13·8	+8·9
1936	62·8	+14·9	+14·4	+10·5	+6·0
1937	70·5	+27·2	+20·7	+19·5	+7·6

The immediate response to artificials every year is thus greater than the immediate response to compost every year. Further, as is to be expected, the responses to both manures are greater on plots without manuring in the previous year than on plots which were then manured. The average differences between the increases due to artificials and those due to compost are 3·7 cwt. per acre on plots unmanured in the previous year, and 7·0 cwt. per acre on plots manured in the previous year. The results indicate that artificials are more effective, relatively to compost, at higher levels of yield. The residual effect of the

compost on plots receiving no manure was better than that of the artificials, compost giving about 6·7 cwt. per acre more than artificials did. Where, therefore, the land was manured every year the artificials gave the better results, but where it was manured only in alternate years the compost has proved as good as the artificials, the loss in the first year being made up by the gain in the second.

In tropical countries, however, where labour is very cheap, the position is different from that prevailing in Britain, and there more interest is taken in compost making. Wood has recently summarised the results of experiments made at the Imperial College of Tropical Agriculture, Trinidad (Ref. 28), and shows that, under the prevailing conditions, aeration and moisture were the most important factors in securing the desired result, and no correction for acidity was needed. No fixed cost could be given; the chief factor determining cost was the time available for making the compost—the more rapidly decomposition was wanted to occur, the more expensive the process became. The labour involved was 13½ man hours per ton of compost and the cost of the final compost was 65 cents to 1·35$ (=2*s*. 6*d*. to 5*s*. 7½*d*.) according as the material was chaffed or not. The final compost was, however, very variable; its nitrogen content was usually about 1 to 2 per cent., but no definite rules for making it could be laid down, even when a start was made with standard material. No field experiments are recorded, but this is in no way peculiar: in spite of all that has been talked and written about composts I know, as yet, of no good set of field results that can be quoted.

Experiments in Southern Rhodesia are recorded by S. D. Timson (Ref. 29) who used the Indore process and made one field experiment comparing a green-manure crop, ploughed under in the ordinary way, with a similar crop composted and then ploughed under. The latter gave the better result. The heaps were made during the dry season, and turned during the spring rain so as to allow the water to get in.

Soil Tilth and Soil Structure.

Everyone knows in a general way what is meant by tilth, but it is extremely difficult to make any good definition. The soil can be broken down by the processes of mechanical analysis into its ultimate particles, and these can be grouped as sand, silt, clay, etc., all of which are somewhat conventional though they are now the subject of international agreement. But in natural soils these ultimate particles are built up into crumbs or aggregates, and it is these that are really important for tilth and cultivation. The ultimate particles do not fit closely like

bricks in a building, and so there is a good deal of empty space between them : this is called the pore space and in most soils this empty space is at least as great as the space occupied by the actual particles. There are two kinds of pore space : the pores in the crumb, and those between crumbs; so far it is not easy to distinguish between them. But the pore space is important because it is here that the water is stored for the growing plant, and also because it is the channel along which air penetrates to the plant roots.

Two other properties of the crumbs are also important : their size, and their stability. Much of the terrible soil erosion that has had so devastating an effect on agricultural regions in the drier parts of the world has arisen because the soil crumbs lost their stability and fell down to their ultimate particles which then were easily washed or blown away.

A considerable amount of research has been done on the subject, especially in Russia, but most of the papers are not very accessible. The results have recently been collected by E. W. Russell (Ref. 30) who is himself working on this subject at Rothamsted.

It is not necessary here to discuss the physical aspects of the subject : I shall here confine myself to the methods by which the structure of the soil is altered.

Effect of moisture content.—Several years ago it was shown by Vassilenko and Setzinsky, and also by Vilensky and Germanova (Refs. 32, 33) in the Ukraine that the properties of the soil aggregates depend on the moisture content at the time when they are formed. This of course is simply a more precise way of saying, what every farmer knows, that the tilth depends very largely on the moistness or dryness of the soil when it is worked. But the more precise way of putting it has the advantage that the problem can be brought into the laboratory for proper investigation. Aggregates formed at the optimum moistness keep up when wetted, *i.e.*, they have maximum stability and also considerable mechanical strength against breaking by compression. This optimum moistness was, for the soil examined, about the same as the "sticky point" (Ref. 34). It is not a rigidly fixed quantity, however, but depends somewhat on the pressure applied when the wet soil is worked or kneaded : but for practical purposes one can speak of a critical moisture content at which stable crumbs or aggregates form most easily.

A useful application of this fact has already been made in Russia. Gorkova (Ref. 35) found that the hard impermeable surface cap, which forms very easily on certain saline soils containing alkali chlorides and sulphates, could be prevented from forming if the soil was cultivated when it was at this critical moisture content, for on drying a stable and desirable

structure was produced that considerably reduced the risk of cap formation.

Each type of implement has its own individual action on the soil structure, and this action is dependent on the moisture content of the soil. If the soil is worked at a moisture content not very much drier than that for optimum structure formation, ploughs, cultivators and rotary cultivators all have much the same effect on the soil aggregates: they may either break an aggregate into a few smaller ones or make a few aggregates form a single one, but in general only very few aggregates smaller than ½mm. (1/50th inch) are produced. But if the soil is drier than this the difference between the mouldboard plough and the cultivator or rotary cultivator becomes marked.

Tsyganov (Ref. 36) has given a good example of these effects. He compared the structure of a soil when it was cultivated fairly dry (near its wilting point) and quite moist (near its "field capacity") by ploughing and light discing and by ploughing and intensive discing. The damp soil gave a larger proportion of crumbs of 5mm. (1/5th inch) or more diameter than the dry soil, and only a small proportion of minute crumbs (below ¼mm.= 1/100th inch diameter), and the 20 discings gave more of the large crumbs than the 4 discings. But under dry conditions the opposite result was obtained: the soil broke down to minute fragments instead of remaining in the larger crumbs, and the 20 discings increased still further this proportion of powder. The figures are :—

Effect of Cultivation on the percentage of field aggregates and water-stable aggregates.

Soil Cultivated near	Field Aggregates.				Water-Stable Aggregates.			
	Wilting point.		Field capacity.		Wilting point.		Field capacity.	
Aggregates size in mm.	above 5	below ¼	above 5	below ¼	above 1	below ¼	above 1	below ¼
Before Cultivation ..	40	21	12	30	48	23	13	40
After 2 ploughings and 4 discings	20	16	33	11	54	19	44	24
After 2 ploughings and 20 discings	16	28	40	11	39	28	30	31

Pigulevsky (Ref. 37) compared the effects of a rotary cultivator and a plough on a soil when it was fairly wet and also when it was fairly dry. Neither implement produced any appreciable amount of aggregates finer than ½mm. when working in the damp soil, but when working on a drier soil there were

28 per cent. of aggregates finer than ½mm. on the rotary cultivated plot while there were only 12 per cent. on the ploughed plot. Chizhevsky and Kolobova (Ref. 38) also found, when working on fairly dry soil, that the plots which had been worked with a cultivator contained 14 per cent. of aggregates finer than ¼mm. while those ploughed contained only 3 per cent. This effect of cultivation in reducing to powder a soil that is too dry, but building it up into stable crumbs if it is sufficiently moist, explains the harm done to soil texture by too frequent fallowing in arid or semi-arid regions.

Cropping, however, tends to build up the soil particles, and Krasinsky (Ref. 39) found that even such a widely spaced row-crop as maize could apparently build up the structure broken down by cultivation. He sowed maize on a series of plots on a degraded chernozem soil whose structure had been progressively destroyed by continued harrowing; after 1—2 months he could not detect any difference in the structure of the soil on the different plots. The most striking effects, however, are those produced by growing grasses and clovers. This has long been known in practice, but the first actual measurements appear to have been taken by Pavlov (Ref. 40) and later Geltzer (Ref. 41) working on irrigated grey desert soil in Turkestan. Some of their results were :—

Previous Cropping.	Water-stable aggregates ¼ mm. (per cent.)
3 years clover	35
2 years cotton, then 1 year clover ..	27
2 years clover, then 1 year cotton ..	17
3 years cotton	9
Old arable	4
3 years lucerne	20
6 years lucerne	30
Old irrigated meadow	79

This result has been found to hold on the Russian podsolised soils. Ilmenev (Ref. 42) and Savvinov (Ref. 43) working on an experimental field at Timiriazev Institute, Moscow, found that the soil structure was worst on the plots that had been fallowed since 1912, best on those that had carried clover since then, and intermediate on those that had carried rye.

They found the following mean percentages of water-stable aggregate larger than ¼mm. on plots carrying the following crops :

——	Fallow since 1912.	Rye since 1912.	Clover since 1912.
Ilmenev	39%	67%	76%
Savvinov	6%	39%	65%

Savvinov also determined the percentage of water-stable aggregates larger than ¼mm. on some of the Rothamsted plots for comparison with those for the Timiriazev plots, and found the following percentages :—

Fallow since 1843 (pathway between 2 plots).	Wheat since 1843 (mean of unmanured and complete artificials).	Wheat since 1843 dunged plot.	Old grassland.
22%	34%	52%	84%

The good soil structure that is formed under perennial grasses and clovers is fairly stable to cultivation for several years. Tjulin and Birjukova (Ref. 43) claim that the stability even increases for one or two years after breaking up the sod, and Kvasnikov and Timofeev (Ref. 43) found the same effect in one of their experiments. This may be true but it is not yet fully proved. The improvement in texture resulting from the growth of grass and clover is, however, beyond dispute. It may be brought about in the same way as the improvement effected by continued use of farmyard manure. Occasional dressings are not very effective: the Russian experiments show but little improvement from these and even this seems to vary with the season. Thus in two successive years two workers obtained quite different results at the same Station, the Timiriazev Station near Moscow: Ilmenev (Ref. 44) in 1935 found that dung increased the amount of water-stable aggregates larger than ¼mm. by about 4–10 per cent. of the total weight of the soil; while Savvinov in 1936 found that dung had no effect except on the continuous fallow.

The effect of adding dung and lime simultaneously appears to be more beneficial than the sum of the effects of the two fertilizers separately, excepting where large dressings are added. Tjulin and Birjukova (Ref. 43) working with a podsolised soil from the neighbourhood of Perm, and Ilmenev (Ref. 45) working with one from Moscow obtained the following results :—

Increased percentage of water-stable aggregates (7½ mm.) due to the addition of dung, lime, and dung + lime to a podsol on which oats were growing.

Author.	Lime.	Dung.	Lime and Dung.	Extra effect due to the combination.
Tjulin	4·1	12·4	19·8	3·3
Ilmenev	9·0	5·8	19·4	4·6
Ilmenev (3 times the previous dressings) . .	13·4	15·8	22·9	−6·3

An explanation of the results has been put forward by Geltzer (Ref. 46). He found that green manuring improves the soil structure of the grey desert soils of Turkestan more than dung and, in view of the fact that green manure decomposes in the soil more rapidly than dung, he attributes the improvement not to the organic matter but to its decomposition. In confirmation of this view he showed that if cellulose is added to the soil in such a way that it can be decomposed rapidly, an excellent improvement of structure takes place, but a break-down begins as soon as decomposition has ceased. Kanivetz and Korneeva (Ref. 47) have also confirmed this result by showing that cellulose and potassium nitrate give as good a structure as dung, and that mixing cellulose with dung gave no extra improvement.

If soil structure is effectively improved only by the decomposition of organic matter it becomes easy to explain the increased effectiveness of lime and dung when acting together: the lime has hastened the decomposition of the organic matter.

On the other hand, lime by itself has not always done much in the way of improving soil texture: it may act well on an acid soil, but it has even done harm on neutral soils. Tjulin and Birjukova, and also Ilmenev, working on acid podsolised soil, found that lime definitely increased the amount of water-stable aggregates present, although its first effect, particularly in large dressings, was to reduce the amount of water-stable aggregates. Renner (Ref. 48) in Germany, found that lime did not improve the structure of the soils with which he worked, but he did not investigate the question whether its ineffectiveness was due to the fact that the soil was already neutral. Demolon and Henin (Ref. 49) found that lime definitely harmed the structure of their neutral light sandy loam. Again, heavy clay soils can contain some free calcium carbonate and yet be almost devoid of a granular structure. The field evidence for the connection between a good, stable structure and lime is thus not very clear.

The laboratory evidence is more definite: Baver (Ref. 50) and Myers (Ref. 51) each showed that, in the laboratory, acid-washed soils seem to have at least as stable a structure as neutral ones, a result that is in agreement with a number of laboratory observations made by E. W. Russell at Rothamsted: merely to convert an acid-washed soil into a neutral one does not improve its structure.

On the other hand, artificial fertilizers used in the ordinary way have little effect on the soil structure; if anything the effect is usually slightly beneficial, probably because of the stronger plant growth which takes place under the fertilizer treatment. Abnormally large quantities of salts are, however, harmful.

The effect of weather conditions on soil structure is very marked but is not fully understood. Rain in several ways reduces the size of the aggregates; they may be unstable in water and so fall down to a paste when wet; this happens, for example, with some alkali soils; or they may be broken up by some secondary effect of wetting, such as uneven swelling or the disruptive influence of the absorbed air which is released; or again they may be broken up mechanically by the pounding effect of a heavy rain storm, and the dispersing of the smaller aggregates as they are detached. This destructive effect of a rainstorm on the aggregate structure increases with the intensity of fall, and very few soils possess a sufficiently stable aggregate structure on their surface to prevent them from "capping" badly after a heavy storm.

The effect of drying a wet soil depends on the size and type of structural aggregates present in the wet soil. If the aggregates in the wet soil are smaller than a certain size, which depends on the type of soil, a clod is produced.

The effect of freezing is more complex: it can lead either to the formation or to the breaking up of clods according to the conditions. Frost breaks down clods and in some circumstances builds up good aggregates. These effects are not yet well understood, but they are under investigation.

Cultivation.—Reference was made last year to the experiments of B. A. Keen and E. W. Russell on cultivation (Ref. 52). These are still being continued. Mention should also be made of two other investigations, one by C. Culpin (Ref. 53) on the effect of rolling on the soil and the other by O. V. S. Heath (Ref. 54) on the effect of soil cultivation on the growth of cotton; in this Heath shows, as the late Spencer Pickering had done for fruit trees, that growth is better on consolidated than on looser soil.

Soil Analysis.

Ever since chemists have studied agriculture they have endeavoured to find some means whereby soils could be analysed so as to find out what fertilizers must be added to in order to ensure good growth of crops. So far back as 1805 the Bath and West Society set up a chemical laboratory for this purpose. It was the first in this country if not in the world, and in the early publications of the Society some of the results are published with the intimation that the farmer who wishes to understand them "must previously have acquired at least the outlines of chemical science before he can be made acquainted with the minutiae of analyses, the acquisition of which falls to the lot of few farmers, artists or manufacturers." A modern agriculturist would find it extremely difficult to utilise the analyses quoted (Ref. 55).

History does not show what success was obtained, but the Society continued to flourish. From that time onwards chemists have struggled with the subject with varying degrees of success. To-day a shrewd analyst, with knowledge of the district and of the results from past fertilizer trials in the locality, can generally give sound advice to farmers; sometimes, however, the advice would fail to be justified by careful field tests.

Dr. E. M. Crowther at Rothamsted is attacking the subject again, using as material the large number of experiments carried out by the Rothamsted staff on commercial farms in different parts of the country. Samples of the soils are examined by a variety of laboratory methods so as to see how far each of these would have made it possible to forecast the response of the crops to added fertilizers. In 1936 there was a fair correlation between the response to sulphate of ammonia and the amount of inorganic nitrogen in the soil samples after incubation. For phosphoric acid the fraction soluble in acetic acid was significantly related to the responses to superphosphate, the agreement being better in 1936 than in 1937. The more commonly used citric acid method was less successful. For potash, neither the water-soluble nor the acetic-acid-soluble fractions were significantly related to the field responses in 1936, though they were in 1937.

When the data were set out in groups, according to textural classes of soils, it became clear that fertilizer recommendations, whether based on soil analyses or not, must take account of soil texture. Thus it happened that, on the heavy soils, the yield of sugar beet was depressed by potassic fertilizers in 1936, despite the fact that some methods of soil analysis actually in use always indicated less "available" potash in the heavy than in the light soils. The field experiments hold out considerable promise that soil analysis may give useful results for soils of normal fertility, provided the methods have been standardized by reference to actual field trials on related soils.

Soil analysis is much more usual on the Continent than here. In Holland it is done on a colossal scale. A laboratory at Grongingen under Prof. de Vries, devoted entirely to this work, has no fewer than 80 assistants, all of them girls from the Middle Schools who came to the work with no knowledge of chemistry. These assistants are in charge of one or two graduates and they make rapid determinations of soil reaction (*p*H value), calcium carbonate, potash and phosphate. The whole work is arranged on mass production lines and thousands of analyses are made in the course of the year. Farmers are very interested in the work and cheerfully pay for the analyses (Ref. 56).

The German survey methods have been described in earlier Reports. Both the Mitscherlich and Neubauer methods are used and discussion still continues as to which is the better (Ref. 57).

Mitscherlich's method was tried out on ten soils in Northern Ireland and in about six or seven cases the forecasts of response are described as "reasonably correct." The authors doubt whether any other method would have done so well (Ref. 58).

It has sometimes been claimed on the evidence of pot experiments, that certain *proportions* of plant foods give the best returns for particular crops but it is now known that the proportions may vary widely, so long as enough of each food is given. This question is well discussed by the distinguished French expert, A. Demolon (Ref. 59), and also by A. Jacob (Ref. 60).

The United States Department of Agriculture has had probably more experience of soil surveys than any other Institution in the world, and has developed an admirable series of methods especially adapted for dealing rapidly with large areas. These methods can also be used for small, intensive surveys. The Department is now developing aeroplane surveys. The methods have recently been brought together in an excellent handbook prepared by Dr. C. E. Kellogg, in which the details are fully set out (Ref. 61).

The Land Fertility Scheme.

The Use of Lime.—The Ministry's scheme for stimulating land improvement by enabling farmers to obtain lime and slag at reduced rates has led to greatly increased consumption of both these materials—so much so that, in some counties, there have been difficulties about supplies. There can be no doubt as to the advantages of the scheme, for large tracts of arable land had run out of lime and become acid, and lime must be added to put the soil right. It is, however, only a waste of money to apply lime where it is not wanted, and attention is drawn to a useful bulletin issued by the Ministry of Agriculture on the proper way to use lime on the farm (Ref. 62). The County Organizers should, however, in any case be consulted before any great amount of lime is purchased.

Some of the results of the 1936–37 experiments of the Rothamsted staff have an important bearing on the liming programme of the Ministry of Agriculture. In many parts of England there is a dislike of magnesian limestone and of the lime prepared from it. We have made a number of experiments in different parts of the country but have so far obtained no evidence that the magnesian limestones are detrimental. When used in the quantities indicated by the ordinary lime-requirement methods they give fully as good results as the corresponding high-calcium products. In some pot experiments magnesium actually proved beneficial, but no benefit was shown in any of the field experiments. No full survey has been made, but there is no present evidence of wide-spread magnesium deficiency in English soils.

Residual Effects of Chalk.—The residual effects of chalk have been studied in three experiments (Ref. 63). In two of these the dressings of chalk were varied, so that the trials might show the most effective amount to apply.

At Tunstall, on an acid sandy soil, chalk was applied by Mr. A. W. Oldershaw in 1932, but nothing was added afterwards. Sugar-beet was grown for the first four years, 1932-5, then barley in 1936 and clover in 1937. The results are given in Table 12.

TABLE 12.
Residual effects of chalk at Tunstall, Suffolk.

Chalk, tons per acre (1932).	Sugar Beet: Tunstall. Roots, (tons per acre).				Barley Grain.	Clover: Hay.
	1932	1933	1934	1935	1936	1937
None	1·82	2·94	Nil	Nil	Nil	5·0
1	12·61	11·40	13·37	14·64	14·5	32·3
2	14·30	13·23	16·36	15·90	17·0	34·9
3	14·27	13·26	16·81	15·43	18·3	37·4
4	14·74	13·91	17·26	15·97	18·4	38·8
Standard error	±0·432	±0·437	±0·332	±0·242	—	±1·04

The experiment has not yet proceeded long enough to tell how long the effects of the chalk will persist, but in the first five years there was little sign that the effects of the 1932 dressings were disappearing. It will be interesting to see whether the effects of the largest dressings persist longer than those of the smaller ones.

Two similar experiments have been carried out by Mr. H. W. Gardner, of the Herts Farm Institute. One was at Stevenage on a gravelly loam soil with somewhat smaller dressings of chalk. The experiment started in 1933 with a crop of lucerne which failed owing to drought. Winter oats followed in 1934; these were undersown with a seeds mixture, which constituted the 1935 crop, while mangolds were grown in 1936. The results given in Table 13 show that the effects of acidity are clearly much less marked than at Tunstall.

TABLE 13.
Residual effects of chalk, Stevenage.

Chalk, cwt. per acre (1933).	None.	35	70	140	210	Standard error.
Hay, cwt. per acre, 1935..	25·5	46·0	59·2	66·0	67·3	±2·70
Mangolds roots, tons per acre, 1936 ..	17·22	24·92	29·12	31·49	31·57	±1·42

The other experiment was on hay at Barnet: 75 cwt. of chalk was given in 1934 but none since: potassic fertilizer was given to some plots but not to others. (Table 14.)

TABLE 14.

Yields of Hay, cwt. per acre: and increase due to chalk applied in 1934.

—	1934.	1935.	1936.	1937.
Mean Yields	16·1	28·8	35·7	25·7
No potash..	+1·6	+5·2	+4·4	+6·3
Potassic fertilizer.. ..	+1·8	+5·6	+12·8	+5·5
Standard error	±0·806	±1·17	±1·55	±1·38

As in the other experiments there is yet no sign that the effects of chalk are dying away, good responses having been obtained in each of the last three seasons. In 1936 the effectiveness of chalk was increased by the presence of potash, the increase from chalk being 12·8 cwt. with potash present, as against 4·4 cwt. with no potash. In other years, however, the response to chalk has not been affected by potash.

The acid plots at Woburn are perhaps better known than any others in the country and Dr. Mann has now published (Ref. 64) a detailed account of the composition and characteristics of the diminutive barley plants growing there. Although almost hidden by the spurrey, they complete their life cycle and produce seed. The plants contain much more alumina and iron, and less calcium, nitrogen and phosphoric acid than those on the more nearly neutral plots. But—and this is the remarkable point—the seed has the normal composition, all the excesses and deficiencies being carried in the straw.

Basic Slag.—The Ministry of Agriculture Basic Slag Committee has continued its work during 1937 and its 15th Interim Report (Ref. 65), is obtainable from the Ministry. This year's experimental work has been concerned chiefly with the study of residual effects which, on oats and hay following the swede crop, have been very small. This, however, may not be entirely the fault of the soil; clover, rye-grass, and also timothy, are able to make use of soil phosphates that are not available to swedes and hence they show no response to phosphatic manures even when the swedes have responded well.

It still remains true, however, that the recovery of phosphate from basic slag is quite small, averaging about 25 per cent. in the experiments so far made. The soil does not appear to be a very good store-house for fertilizers.

The Ministry of Agriculture Leaflet on basic slag (Ref. 66), has been revised and brought up to date and should be consulted by the farmer before he places a substantial order.

Electric Soil Heating.

F. E. Rowland (Ref. 67) has described methods whereby soil can be heated electrically up to a sufficient point to hasten the growth of plants in frames or in glass houses. The method is simple and results of market gardeners' experiences with it are given.

Grassland.

A summary of the general principles of grassland improvement has been published by W. Davies (Ref. 68) in which the problem of soil fertility is discussed. He points out that unimproved pastures on phosphate-deficient soils almost always lack clover, and the keynote of improvement all over the world is the introduction of an efficient legume: in Britain and New Zealand, for example, *Trifolium repens;* in South Australia *T. subterranneum.* Tropical and sub-tropical areas may have to rely upon species of *Medicago, Stylosanthes, Desmodium, Lespedeza* and other genera. The appropriate species differ from place to place but, to be properly efficient in promoting soil and herbage improvement, the pasture legume must be herbaceous, edible and palatable; it should be reasonably aggressive and able to spread even if frequently defoliated. The soil conditions necessary for the growth of clover are ample supplies of phosphate, and (as the Rothamsted experiments have shown) the proper strain of the nodule organism. The nitrogenous residues derived from stock excreta dropped directly on the pastures are said to be more beneficial than the usual inorganic forms of nitrogen. It should, however, be remembered that the liquid excreted contains considerable amounts of potash which is very necessary for the clovers. The best dairy pastures of Cheshire and the fattening pastures of the Midlands are predominantly composed of rye-grass and white clover, and the system of management should be directed to maintaining these species rather than letting them be displaced by other grasses such as cocksfoot, tall oat, Yorkshire fog, fescues, *Agrostis* and tussock grass (*Deschampsia caespitosa*) which begin to come in if the pasture is not properly stocked.

Rothamsted Experiments on Grassland.—Rothamsted experiments on grassland fall into three groups :

(1) The effects of fertilizers on the yield and composition of hay and on the grazing value of pasture land.

(2) The effect of management on the flora of grassland.

(3) The effects of cake-feeding on the composition and nutritive value of the herbage.

The Rothamsted Park Grass plots, begun in 1856, show in a striking way the changes in the flora of grassland that may be brought about by continued fertilizer treatment.

A grass field, originally fairly uniform, has been changed into some 15 or 20 different floral types by varying the manurial treatment. The converse experiment was started in 1928. An arable field was divided into six parts, each of which was sown with a separate grass mixture, then the whole field was put under uniform management, and botanical analyses of the herbage were made periodically. The differences in flora rapidly diminished and by 1936 the plots were all very similar. Grass and clovers occur in approximately the same proportions on all plots, irrespective of the original mixture; ryegrass has become dominant on all plots, cocksfoot has diminished, fescue and timothy have almost disappeared while rough-stalked meadow grass forms a definite though small part of each flora.

This elimination of many of the species sown is probably the general rule though there are exceptions: J Percival records a field in the Thames valley where all species of plants sown were still found after nineteen years.

The survivors at Rothamsted after eight years differ from those recorded by Alan Roberts (Ref. 69) in a survey of pastures in Wales, where the rainfall is much higher than at Rothamsted and where the winter grazing by sheep is harder. At Rothamsted cocksfoot and particularly Italian ryegrass and timothy survived better than in Wales.

Effects of Cake Feeding.—One of the most debated questions in pasture management has been the effect of cake feeding on the value of the pasture. The problem looks simple but actually it has proved very complex. It has considerable practical importance because of the compensation for improvement payable to the tenant quitting his holding.

The investigation of the effects of cake feeding on the composition and nutritive value of the herbage was commenced at Rothamsted in 1936 under the aegis of the Royal Agricultural Society. The experiment is being made on a level and fairly uniform grass field, Highfield, of about 60 acres, which had been indifferently grazed and manured for many years and had, therefore, become distinctly poor.

The plots, each of 5 acres, are arranged in three blocks, each of three plots. In each year one block of three plots will be grazed by bullocks and on one of the plots cake will be fed. In the next year there will be no cake fed, but another of the three plots will receive, during the winter and spring, artificial fertilizers containing the estimated manurial equivalents of the cake. The third of the plots will be left unmanured. All three plots will then be grazed by bullocks and sheep in the proportion of 3 sheep to 1 bullock, all live-weights being recorded. From the increases in live-weight we shall be able to compare the residual values of the manure with the values of artificials supplying their

supposed equivalents. In the third year no plots will be manured, so that any subsequent effect of cake feeding or of artificials can be estimated (Ref. 70).

Carotene and grass.—At the present time a good deal of interest is taken in the carotene content of grass, especially dried grass offered for sale on the market. We are not here concerned with the question of its value to the animal, but only with the ways of increasing its amount in the herbage. The older work done by Virtanen in Finland showed that the production of carotene in the plant is related to the nitrogen supply and that nitrate was better than ammonium salts as a source (Ref. 71). This result has now been extended by Thomas and Moon (Ref. 72), who show that dressings of sulphate of ammonia increased both yields of grass and percentages of carotene, so that the amount of carotene in pounds (or rather in ounces) per acre was nearly doubled: the quantities of carotene are only small in any case. The average total yields from five monthly cuts of grass, from June to September 30, were:—

—	Lb. per acre.	
	No Manure.	Sulphate of Ammonia.
Dry Matter..	502	714
Crude Protein	95	153
Carotene	0·20	0·39

Grass and water supply.—The preponderence of grass in the western part of Great Britain is the result of the great need that grass has for an abundant water supply. Even the western rainfall is not always sufficient. Irrigation from a water channel on a farm in Breconshire increased not only the growth but also the palatability of the herbage: and the differences in palatability between different species and strains tended to disappear (Ref. 73).

Alternate husbandry.—Oxford is peculiarly well placed for holding Agricultural Conferences, and during the last few years the School of Agriculture and the two Research Institutes have organized a new type of Conference lasting several days, where the members can stay in the Colleges and so have opportunities of meeting informally. The Proceedings of the last Conference are available in a printed volume, but a good summary was published by Sir Daniel Hall (Ref. 74). The main subject was the management of temporary grassland, or alternate husbandry as it is now often called. But, as Sir Daniel points out, this term is ambiguous. To the Englishman of the South it means the complete replacing of the old rotation by an alternation of 3, 4 or 5 successive corn

crops with the leys down for about the same length of time, roots being almost eliminated: while in Scotland it simply means the common practice of having a long ley in place of the one-year ley of the four course rotation, the roots being retained.

Another Conference on the subject was organized by the Surveyors' Institution at which papers by R. G. Stapledon, the present writer, and others were presented (Ref. 75). Prof. Stapledon has in recent years given great publicity to the use of longer leys instead of single-year leys, and the more frequent ploughing up of permanent grass land with subsequent reseeding. Temporary grass is not only usually freer from parasitic disease organisms, but it also gives a higher yield than permanent grass, and where it is possible for the temporary grass to remain for a few years, as a long ley, the increase may be expected to continue.

I am not here concerned with the management of the grass but only with the soil problems. One of these is the difficulty of getting a ley established on heavy soils in dry conditions, especially where, as in the Eastern counties, spring droughts are liable to occur. There is no certain way of overcoming this difficulty, and as yet long leys are not common in the Eastern counties. Another problem lies in the cashing of fertility when the ley is ploughed up. Grassland harbours insects, some of which, including wireworms, do much damage to crops. Recent counts at Rothamsted show up to 400 million insects per acre in winter and 200 million per acre in summer on old grassland. These figures compare with about 150 million per acre, in winter, on arable land—except where annual dressings of dung are given, when the numbers are of the same order as those on grass. The rate of piling up of the numbers is not known, so that one cannot say how the population after four years ley would compare with that of old grass. Much work is being done now at Rothamsted on soil insecticides with a view of finding some way of checking the damage done by the insects to the corn crops.

A second difficulty is that the mat which forms in some old grass is difficult to decompose when the grass is ploughed up, especially if the season is dry. The decomposition is hastened, however, if nitrogenous manure is given. This question of the decomposition of the mat has been discussed by H. L. Richardson (Ref. 76). Further, if several corn crops are taken in succession there is the difficulty of fungus diseases accumulating in the soil, especially Take-all and the lodging disease caused by *Cercosporella*. These are being studied by Dr. Garrett and Miss M. D. Glynne (Ref. 77) at Rothamsted.

Experiments on the ploughing out of grassland and on the advantages and disadvantages of various sequences of crops are now being started at Rothamsted.

Fodder Crops.

More Home-Grown Proteins and Starch Equivalents.

On page 327 it is shown that 72 per cent. of the protein equivalent and 80 per cent. of the starch equivalent required by the livestock of the United Kingdom are grown here, the rest being imported. If it were deemed desirable to reduce our dependence on foreign feeding stuffs the only way, of course, would be to produce more animal food at home and this can be done by a fuller use of fertilizers. Table 15 drawn up by H. V. Garner shows the amounts of protein equivalent and of starch equivalent that can normally be expected to result from the addition of 1 cwt. per acre of nitrate of soda, nitrochalk or sulphate of ammonia. Kale is the most efficient producer of protein equivalent, followed closely by wheat, barley, oats and meadow hay: potatoes, swedes and mangolds are not so good. When account is taken also of the starch equivalent, the whole gain in food value is greatest for barley and potatoes, followed by kale, oats, wheat and mangolds: swedes and meadow hay give less increase.

On the average of prices both of fertilizers and of feeding stuffs ruling during the year April, 1937 to March, 1938 it appears that one lb. of nitrogen in sulphate of ammonia, costing 4*d.*, gave increased food stuffs worth 8*d.* to 1*s.* 8*d.*, the average being between 1*s.* 2*d.* and 1*s.* 3*d.*

Table 15.

Food value produced by Nitrogenous fertilizer (Sulphate of Ammonia).

Basis of calculation, mean of monthly values over period April 1937–March, 1938, published in *Journal of the Ministry of Agriculture.*

1 unit (22·4 lb.) starch equivalent is worth 2·16*s.*

1 unit (22·4 lb.) protein equivalent is worth 0·68*s.*

—	Usual increase per 1 cwt. Sulphate of Ammonia.	Protein equiva-lent.	Starch equiva-lent.	Produced by 1 cwt.		Value.	Value per pound Nitrogen (costing 4*d.*).
				Protein equiva-lent.	Starch equiva-lent.		
	cwt.	%	%	lb.	lb.	*s.* *d.*	*d.*
Potatoes ..	20	0·6	18	13	403	39 3	20
Mangolds ..	32	0·4	7	14	251	24 7	13
Swedes	20	0·7	7	16	157	15 7	8
Kale	30	1·3	9	44	302	30 5	16
Barley, grain ..	3½	6·2	71	23 } 28	258 } 391	25 7	13 } 20
,, straw ..	6½	0·7	19	5	133	13 0	7
Oats, grain ..	2½	7·6	60	21 } 27	168 } 282	16 10	9 } 15
,, straw ..	6	0·9	17	6	114	11 2	6
Wheat, grain ..	2½	9·6	72	27 } 33	212 } 274	21 3	11 } 14
,, straw ..	5	0·1	11	6	62	6 2	3
Meadow Hay ..	5	4·6	31	26	174	17 7	9
			Mean.	25	279	27 8	14½

(The protein and starch equivalent are taken from "Rationing of Dairy Cows," Dept. Com. Rept. Min. Agric., 1925.)

Kale.—Marrow-stem kale is one of the most useful of fodder crops and one of the best converters of cheap fertilizer nitrogen into valuable protein food for animals. Numerous experiments on the manuring of kale recorded in the Rothamsted Report (Ref. 78) show that responses continue even up to 6 cwt. of fertilizer per acre, whether dung is given or not. One of the experiments at Woburn showed that a dressing of 15 tons of dung had about the same effect as 2 cwt. sulphate of ammonia per acre.

Beans.—Field beans have formed the subject of few experiments, yet they have considerable value as fodder. During the past four years (1934–1937) several manuring experiments have been made at Rothamsted (Ref. 79).

Dung has given an increased yield, though only in 1935 was the effect large. Nitrochalk has had little effect, while potash gave increases in 1935 and 1937, and superphosphate increased the yield in 1937.

The results suggest that the bean crop is not very responsive to fertilizers. While farmyard manure has given increases, there seems no reason to invoke any special action beyond what is due to the nutrients present.

The narrow spacing (16–18 ins.) proved superior to the wide spacing (24 ins.) in both years (1935 and 1937) in which it was tested, giving increases of 2·8 cwt. in 1935 and 7·7 cwt. in 1937; the mean yields were 21·0 cwt. per acre in 1935 and 29·0 cwt. per acre in 1937.

Crops Used for Human Food.

Brussels Sprouts.—The Brussels sprout crop takes up very large amounts of plant nutrients from the soil: Lewis (Ref. 80) estimates these as follows:—

Nitrogen	200–300 lb.
Phosphoric acid (P_2O_5) ..	60–90 lb.
Potash (K_2O)	170–240 lb.
Lime (CaO)	170–270 lb. per acre.

The larger part of these nutrients is absorbed during the third and fourth months of growth, and not during the first few weeks: it is possible that this absorption may account for some of the good results obtained with poultry manure.

Sugar Beet.—The experiments on sugar beet carried out under the aegis of the Sugar Commission have been continued, and a summary of the 1937 results was communicated to the National Farmers' Union (Ref. 81). They differ somewhat from those of previous years.

During the first three years 1933, 1934 and 1935, the responses to fertilizers were comparatively small. The summers were hot and dry, and apparently provided little opportunity for the phosphate and potash to exert their full effects. Nitrogen was the only fertilizer to justify itself, on the average, in these years, and the single dose of potash came next in order of effectiveness. In 1936, however, there were good responses to all nutrients and especially to phosphate; the results provided our first favourable opportunity for relating field responses to chemical analysis of the soils. In 1937 the responses to nitrogen and phosphate were less than in 1936, but the results from potash were the best so far recorded.

The mean increases due to each of the three nutrients, in terms of sugar per acre, are given in Table 16.

TABLE 16.

Mean Responses to Nutrients in Single and Double Dressings. 1933–1937. *Sugar (cwt. per acre).*

Year.	No. of expts.	Mean Yield of roots	Mean Yield of sugar.	Sulphate of ammonia.		Super-phosphate.		Muriate of potash.	
				2 cwt.	4 cwt.	3 cwt.	6 cwt.	1½ cwt.	2½ cwt.
1933	13	11·5	37·5	+0·4	—	+0·3	—	+0·8	—
1934	15	13·5	47·6	+1·8	+3·0	+0·4	+1·0	+1·4	+0·4
1935	23	9·5	32·4	+1·8	+2·7	+0·1	+0·4	+0·8	+0·9
1936	26	10·4	36·6	+5·5	+7·7	+1·9	+3·0	+1·2	+1·9
1937	30	11·6	40·3	+3·8	+5·2	+1·5	+1·9	+1·5	+2·8

Nitrogen to the amount of 4 cwt. sulphate of ammonia per acre has almost always been profitable except on rich silts and fens. (Table 17.)

TABLE 17.

Effect of Nitrogenous Fertilizers on Different Soils. Increases (+) *or Decreases* (—) *in Sugar* (*cwt. per acre*).

Year.	Sulphate of ammonia.	Coarse sands.	Fine sands.	Light loams.	Heavy loams.	Clay loams.	Fens.
	cwt.						
1936 ..	2	+8·3	+4·4	+4·0	+4·9	+7·0	+3·1
	4	+11·6	+5·9	+5·6	+9·2	+9·9	+0·8
1937 ..	2	+6·1	+3·0	+2·9	+3·4	+4·7	+0·6
	4	+7·1	+4·3	+5·4	+4·5	+6·6	—2·6

Nitrogen almost invariably reduces the sugar content but this loss is more than compensated by increased yield.

The effectiveness of nitrogen on the yield of sugar per acre falls off as the dressing increases from 2 cwt. sulphate of ammonia per acre to 4 cwt. On the tops, however, the effect of nitrogen is so marked that there is no sign of falling off even when 4 cwt. sulphate of ammonia is given.

Phosphate varies in its effect from centre to centre and from season to season. The smaller dose of 3 cwt. superphosphate per acre was profitable on the average of all centres in 1936 and 1937, while the double dose was profitable over all centres in 1936 only. The sugar content is practically unaffected by phosphate, but the rate of growth of the young plant seems to be benefited in many cases. Up to the present, basic slag has been no better than superphosphate, even on acid soils, but rather the reverse. The effect of phosphate on tops is in the same direction as on roots, but somewhat smaller. (Table 18.)

TABLE 18.

Effect of Phosphatic Fertilizers on Different Soils. Increases (+) or Decreases (—) in Sugar (cwt. per acre).

Year.	Super-phosphate.	Coarse sands.	Fine sands.	Light loams.	Heavy loams.	Clay loams.	Fens.
	cwt.						
1936 ..	3	+2·3	+1·3	+3·0	+0·6	+2·5	+1·2
	6	+4·2	+2·7	+3·7	+1·2	+4·3	+0·2
1937 ..	3	+1·2	+0·7	+2·6	+0·5	+0·5	+2·2
	6	+1·5	+1·4	+2·9	+2·3	+1·0	+1·0

Potash has generally worked well on the lighter soils and on the fens but has had much less effect on the heavy loams and clays. (Table 19).

TABLE 19.

Effect of Potassic Fertilizers on Different Soils. Increases (+) or Decreases (—) in Sugar (cwt. per acre).

Year.	Muriate of potash.	Coarse sands.	Fine sands.	Light loams.	Heavy loams.	Clay loams.	Fens.
	cwt.						
1936 ..	1½	+1·8	+2·6	+0·3	+0·2	0·0	+2·1
	2½	+3·8	+4·4	+1·5	—1·2	—1·4	+4·2
1937 ..	1½	+2·6	+1·7	+1·4	+1·8	+0·6	+1·0
	2½	+4·0	+3·4	+2·4	+0·7	+1·1	+3·2

Potash almost always improves the sugar content and also has the valuable property of bringing out the full effect of nitrogenous manures; the joint action of nitrogen and potash has

usually been greater than the sum of their separate effects. Potash also increases the tops, but to a less extent than the roots.

The effect of fertilizers on plant number per acre is somewhat variable but is usually small and favourable.

Continental experiments with sugar beet.—Continental experience also proves the importance of nitrogenous manures : this is shown at the French Institute of Grignon and at the Belgian Sugar Beet Institute (l'Institut Belge pour l'Amélioration de la Betterave). At Grignon Prof. H. Burgevin (Ref. 82) finds, as we do at Rothamsted, that the tops increase proportionately to the amount of nitrogen given in the fertilizer but the roots do not. The purity of the juice, moreover, suffered as the nitrogen in the manure increased.

The increases in yield for nitrogenous manures are very general ; in Saxony (Ref. 83) the following results were obtained as the average for the years 1930–33 :—

Nitrogen (N) in manure, lb. per acre	0	54	72	90
Sugar beet : roots, tons per acre	12·8	14·4	14·9	15·5

Engels (Ref. 84) quotes more definite effects for phosphate :

Superphosphate : cwt. per acre	0	1·6	2·4	3·2
Sugar beet, roots, tons per acre	12·8	13·7	14·5	15·6
,, tops ,, ,, ,, ...	7·5	9·4	10·6	11·2

Other Continental results are given in an interesting popular pamphlet on the history of sugar beet published by the well known firm of Dippe Bros. (Ref. 85).

The Placing of Fertilizers.

An interesting set of experiments has been made in France by M. Lefort, Director of the Experimental Station of Arras (Ref. 86), on the depth at which nitrogenous fertilizers (cyanamide and nitrochalk) should be placed in order to give the best results. For sugar beet it was found advantageous to plough them in to a depth of 6 inches, while for wheat the best results were obtained by working them in with a scarifier to a depth of 4 inches. Harrowing in the manures to a depth of 2 inches was not as good. (Table 20.)

TABLE 20.

Effect of nitrogenous fertilizers worked into the soil to various depths.

—	Cyanamide.				Nitrochalk.			
	Control	2 in.	4 in.	6 in.	Control	2 in.	4 in.	6 in.
Sugar Beet: tons per acre.								
Clay	11·08	12·83	13·64	13·95	11·20	13·15	13·91	14·19
Calcareous soil ..	9·53	10·64	11·48	11·77	9·56	10·88	11·60	11·95
Wheat: comparative yields.								
Clay: Grain ..	100,0	122,9	125,1	118,8	100,0	124,5	126,8	120,0
Straw ..	100,0	125,7	127,6	121,6	100,0	127,5	130,2	123,5
Calcareous soil: Grain ..	100,0	121,0	123,9	117,6	100,0	122,8	125,0	118,4
Straw ..	100,0	124,2	126,2	120,8	100,0	126,4	128,6	123,3

No such clear effects, however, could be obtained by Rothamsted workers. Experiments to compare several methods of applying mineral manures to sugar beet were carried out at five centres in 1936 and six centres in 1937. The treatments consisted of no minerals, minerals ploughed in or broadcast during December or January, and minerals broadcast in spring, shortly before sowing. Though minerals increased the yields at ten of the eleven centres, none of the three methods of application proved consistently superior to the others. The only significant differences occurred in both years on a sandy loam soil at East Kirkby, where winter application proved superior to the spring application (Ref. 87).

DISTRIBUTION OF FERTILIZERS.

In applying fertilizers to crops the proper distribution in the soil is very important and nowadays the work must be done quickly. W. H. Cashmore has described distributors suitable for small and middlesized farms—he includes also accounts of cultivation and other implements (Ref. 88).

SALT AS A FERTILIZER.

Sugar beet and mangolds.—Numerous experiments at Rothamsted and elsewhere have shown the value of a dressing of salt for sugar beet, and the effect seems to be different from that of potash (Ref. 89). Salt has proved consistently the more effective, the average response to 1 cwt being 0·47 tons of roots, while the corresponding dressings of 1·2 cwt. muriate of potash gave an average increase of 0·33 tons roots. Apart from this difference, the effects of the two minerals were generally similar; where one gave a good response, the other did likewise.

Both salt and muriate of potash produced a slight but fairly consistent increase in the sugar percentage.

The striking results obtained with sugar beet have led to other experiments with salt (Ref. 90). With mangolds the following results have been obtained :—

	Mangolds roots : tons per acre.	
	1936.	1937.
Mean Yield	25·50	21·40
Response to :—		
Salt (5 cwt.)	+3·12	+4·92
Muriate of Potash (1 cwt. K_2O)	+0·22	+0·74
Sulphate of ammonia (0·6 cwt. N.) ..	+7·73	+4·95
Superphosphate (0·5 cwt. P_2O_5)	−0·45	+0·22
Dung (10 tons)	+4·20	+2·04
Standard error	±0·675	±0·686

The response to salt is more remarkable in that, in both years, the average response to muriate of potash was small and not significant. Superphosphate had little if any effect.

The value of potash as a general rule is, of course, well established. Its effect in increasing the response to nitrogenous manure (sulphate of ammonia) is strikingly demonstrated in the continuous experiments on Barnfield.

The effect of 10 tons of dung is about half of that of 3 cwt. sulphate of ammonia; a result not far from that recorded on page 334.

Celery.—Experiments on celery were carried out at Mepal (Isle of Ely) in 1935 and 1936. In the first year there were significant increases in total produce of 0·43 tons per acre for 5 cwt. of salt and of 0·89 tons per acre for 3 cwt. muriate of potash. Both minerals also produced a significant increase in the size of heads. The latter result is important commercially, the heads being graded by size when packed for market.

The effect of salt was strikingly different in 1936. Salt was applied in dry weather, six days before planting. No rain fell for some time afterwards. The salt killed a number of young plants and so of course reduced the yield.

Manuring of Potatoes.

For the past thirteen years experiments on the manuring of potatoes have been made at Rothamsted and Woburn and on potato growing farms in different parts of the country: some of the recent results are collected in the Rothamsted Report (Ref. 91).

A dressing of $1\frac{1}{2}$ cwt. sulphate of ammonia, $4\frac{1}{2}$ cwt. superphosphate and $1\frac{1}{2}$ cwt. sulphate of potash per acre usually gives a good result even when farmyard manure is also supplied, but double this dressing may not give a sufficiently greater increase to pay for the extra manure. Nitrogen (sulphate of ammonia) has given the most consistent increases both on mineral and on fenland soils, whether dung is added or not. Phosphate and potash have given marked increases on fenland soils, greater indeed than on the mineral soils.

The results resemble those for sugar beet in that the effects of phosphatic and potassic manures vary considerably from soil to soil: attempts are being made in the Chemical Department to find some chemical method of ascertaining beforehand whether the soil is or is not likely to respond.

The proportion of ware.—Garner (Ref. 92) has recently collected all the results relating to the percentage of ware, and finds that fertilizers have a very marked effect in raising the proportion of ware in cases where the percentage without manure is low, but not where it is already high.

Early potatoes.—The Jersey method of growing early potatoes has been described by D. Simpson and T. Small (Ref. 93). Only the manuring concerns us here: it is extremely heavy: the basal manure is seaweed or dung with bones, mineral phosphate, potash and organic nitrogenous materials turned in; sometimes also green crops of turnips, mustard, or buckwheat are ploughed in. Just before planting a mixture of artificial fertilizers in the proportion of $6\ N : 18\ P_2O_5 : 5\ K_2O$ is harrowed in at the rate of 16 to 22 cwt. per acre. It is not surprising to learn that the cost of cultivation is about £55 per acre: the yields are about 8 tons per acre at the beginning of the lifting season in early June, and rise to about 11 tons per acre towards July. On the earliest sandy soils lifting begins in May, the yields being about $2\frac{1}{2}$ tons per acre, rising later on to 7–8 tons per acre.

This proportion of nutrients—roughly $1\ N : 3\ P_2O_5 : 1\ K_2O$—is rather different from the Lincolnshire formula of $1\ N : 2\ P_2O_5 : 0{\cdot}2\ K_2O$, for early potatoes or $1\ N : 2\frac{1}{2}\ P_2O_5 : 1\ K_2O$ for main crop potatoes (Ref. 94).

Barley.

The fourth Conference on the growing of malting barley was held at Rothamsted on November 24, 1937, when samples from various important barley-growing districts were graded by an Expert Committee of valuers, Grades 1 to 3 representing pale-ale

barleys and Grades 4 to 6 mild-ale barleys; the price range between grades was about 5*s.* per quarter. The results were discussed by the growers, the valuers and the Rothamsted staff. The autumn-sown barleys gave the better quality, but poorer yield; in Grades 1 to 3 they came out three bushels per acre less than the spring-sown barley. Their superiority in quality, however, is shown by the following figures :—

Grade.	Spring Sown. %	Autumn Sown. %
I, II, III	37·0	90·3
IV	34·9	6·5
V	22·8	3·2
VI	5·3	—
Total	100·0	100·0

There was no appreciable difference in quality of the barleys following corn as compared with those following sugar beet or mangolds, but the latter gave about 3 bu. per acre more than the barley following corn. (Table 21.)

TABLE 21.

Average Yield in bushels per acre.

Grades.	Previous crop.							
	Corn.		Beet or mangolds.		Kale or Turnips.		Seeds.	
	No.	Av. yield.	No.	Av. yield.	No.	Av. yield.	No.	Av. yield.
I, II, III	46	34	29	36	6	37	5	33
IV	30	31	19	34	11	37	5	37
V	21	33	9	37	4	27	3	31
VI	3	30	2	41	3	31	1	24
Total	100	33	59	36	24	34	14	33

Nearly three-quarters of the barleys had been grown with artificial manures including some with both artificials and organic manures. Very few were grown without manure. The manured samples came largely into the top grades and one-third of them had received the new concentrated compound fertilizers. Nitrogen was always included, usually at the rate of 20 lb. nitrogen per acre, equivalent to about 1 cwt. sulphate of ammonia. (Table 22.)

TABLE 22.

The Manuring of the various samples.

Grade.	No Manure.	Artificials only.	Organic Manures.	Organics and Artificials.
I, II, III	7	57	19	15
IV	8	33	17	11
V	3	22	10	9
VI	—	3	5	2
Total	18	115	51	37
Percentage, 1937.. ..	8	52	23	17
Percentage, 1936.. ..	14	44	30	12

In an interesting account of modern malting Mr. H. D. Cherry-Downes (Ref. 95) points out that the malting industry of this country is divided into two almost equal sections. Half the maltings in the country are owned and worked by the brewers and distillers themselves: they are generally situated near the brewery or distillery and produce malt solely for the owners. The other half are owned by maltsters who produce different classes of malt for sale to a wide range of customers—brewers of beer and stout, distillers, and makers of vinegar, malt foods for children and invalids and other malt products. This section of the industry usually has its maltings in the grain-growing districts of Great Britain and is, and always has been, closely associated with agriculture.

LEGUMINOUS CROPS: NODULE BACTERIA.

It is well known that leguminous plants, such as lucerne and clover, are dependent for their nitrogenous food on bacteria living in the nodules on their roots. These bacteria are divided into species, each of which can infect only a small group of legumes. Within these species, however, there are strains or varieties that vary very greatly in the amount of benefit they confer on the host plant; some strains indeed are purely parasitic and do not benefit the plant at all: these are particularly prevalent amongst pea and clover-nodule bacteria, and probably account for the poor growth of clover in certain pastures. H. G. Thornton, at Rothamsted, has shown that the clover organisms on certain Welsh hill pastures are of this non-beneficial kind. Usually these "parasitic" kinds are able to dominate the beneficial ones, but a more potent variety has now

been found (Ref. 96) that is not only beneficial but can dominate the non-parasitic kinds :—

Results of mixed Inoculation of Red Clover with good and "parasitic" Strains.

Strains of nodule bacteria supplied in equal numbers.	Total nodules.	Number of Nodules.	
		Produced by good strain.	Produced by "C."
"C" (parasitic) with "205" (good, but not dominant) ..	364	40	324
"C" (parasitic) with "A" (good and dominant)	116	113	3

The discovery of these "dominant" beneficial strains should enable us to use "seed inoculation" to make clover grow well even in soil heavily populated with a "parasitic" strain.

It is very desirable to ascertain whether these inefficient strains of clover organisms are widely spread and Dr. Thornton would be glad to receive from farmers in hill districts samples of clover roots sent in the soil in which they are growing (so that they do not dry out), with the following information: (1) whether the clover is from a short ley or an old pasture: (2) whether the clover grows well or badly.

Clover sickness.—There is some evidence that the important problem of clover sickness is related to the growth of micro-organisms upon or near the plant's roots. The fact that clover often fails when grown too often on the same ground is sometimes attributable to definite fungal or eelworm infections, but there are instances which cannot be attributed to these causes, and in which the commencement of the symptoms occurs so early as to exclude the factor of nodule formation by "parasitic" strains. A case at Woburn has been under investigation by H. G. Thornton and H. H. Mann. A sterile extract of clover-sick soil from this source has been found so toxic that, in its presence, clover seed is prevented from germinating, or is killed immediately after germination. Apparently bacteria growing upon the roots of the preceding clover crop have produced some persistent toxic substance. The nature of this substance and the conditions of its formation are being studied.

It is also true, however, that bacteria growing in the proximity of roots can also produce effects beneficial to the plant. Thus it has been shown in Dr. Thornton's earlier work that the growth of root hairs is stimulated by the secretion of nodule bacteria living outside legume roots. This production of growth-promoting substances by soil bacteria may be of great agricultural importance.

Pyrethrum.

In view of the importance of pyrethrum as an insecticide and of the fact that it grows well on light sandy soil, a number of experiments have been made to see if, by manuring, the yields can be raised to levels at which the crop would become remunerative without at the same time lowering the insecticidal efficiency of the product.

The experiments were made at Woburn, and were continued over four years: both lime and fertilizers increased the yield of flowers and of pyrethrin, the amount of which substance measures the insecticidal value; but in some seasons the effects were only slight.

Crop Growing Without Soil.

Considerable popular interest continues to be taken in the possibility of growing crops in sand or water culture, to which reference was made in last year's Report. The method is very old and has been in regular use in laboratories for some 70 years; but it acquires its recent interest from the suggestion of Professor W. F. Gericke of the University of California (Ref. 97) that it might be used commercially. Some most fantastic accounts have appeared: it was even said that, by the use of this method, enough wheat to feed the whole population of this country could be grown on an area the size of Euston Station. It is only fair to Professor Gericke to say that he is in no way responsible for these statements and a publication recently issued by the University of California puts the whole matter in a much more sober light (Ref. 98). In the popular press much stress was laid on the fact that the yields from tomato plants, properly staked and tended and grown by the water culture method, are much greater than those of tomato plants grown in an open field unstaked and neglected. That is not surprising, and proves nothing about water cultures. Professors Hoagland and Arnon find no reason to expect any great difference between soil and water culture when the plants are grown under comparable conditions, and there is as yet no evidence that English glasshouse growers would obtain higher yields by using water culture instead of soil. The question thus becomes one of economics: whether it is cheaper to set up containers and maintain a supply of culture solution, or to use soil and manures. Experiment and practical experience alone can decide this. A large number of enquiries have come to us at Rothamsted—chiefly from amateurs—asking for instructions for making up the solutions and doing the work. There are no simple formulae, and it is easy to go badly astray. Directions are

given in the University of California booklet for those who wish to try the experiment, but I must emphasise that the method is at present suitable only for glasshouse use, and that there is as yet no evidence of superiority to good soil culture, or that the crops are any healthier; indeed they may be more liable to certain diseases.

This whole question of the feeding of plants is discussed in two interesting recent papers, one by D. R. Hoagland (Ref. 99) and the other by F. G. Gregory (Ref. 100).

The growing of sprouted maize as food for cattle is, of course, a different matter, and lies outside my province. A certain amount of work has been done on this subject recently by the West of Scotland Agricultural College (Ref. 101).

Technique of Field Experiments.

Continuous improvements are being made in the technique of field experiments. The old method of arranging single plots neatly in a row gave place to duplicated plots set out in regular order and this in turn was displaced by R. A. Fisher's randomized replicated arrangements such as Latin squares and replicated blocks. Later experience showed the desirability of some arrangement whereby a larger number of combinations could be included: particularly in the Rothamsted experiments at outside centres, it has been found desirable to test combinations of nitrogenous, phosphatic and potassic fertilizers, each in three different quantities (0, 1 and 2 doses) making 27 treatments in all. An experiment of this sort would be impossibly unweildy if made in a Latin square. R. A. Fisher introduced methods for making this and similar "factorial" experiments. One method is called "confounding": in this the number of plots per block is reduced with, of course, some sacrifice of information, but the scheme ensures that this loss of information shall not fall on the main questions the experiment is intended to solve. In another method some treatments are arranged in main blocks and these are split for other treatments. This is particularly useful for comparing methods of cultivation, or different crops or varieties, when agricultural exigencies require that the work should be continuous on a long strip and not broken up over a number of little plots.

These methods have been considerably developed at Rothamsted by F. Yates and his colleagues: they are set out in several publications now obtainable (Ref. 102) and they are used entirely in the Rothamsted experiments, the Annual Reports on which give numerous examples of each type of design.

An admirable series of well designed experiments was carried out in Egypt by F. Crowther, the results of which were described in last year's Report. Many points of statistical treatment and design arose in connection with these experiments, and these

have now been discussed in a paper by F. Crowther and M. S. Bartlett (Ref. 103).

The analysis of the results is of course not simple, but not impossible for any one even if he is no mathematician who will take the trouble to learn. Some of the difficulties have been explained by W. G. Cochran (Ref. 104).

Overseas Agriculture.

Soil erosion.—Reference was made in last year's Report to the preparation by the Imperial Bureau of Soil Science of a comprehensive publication on soil erosion throughout the world. The publication was issued early in 1938 as Technical Communication No. 36 under the title " Erosion and Soil Conservation." This very extensive survey of the literature, supplemented by detailed memoranda specially prepared by the Bureau's Official Correspondents and others, has revealed that soil erosion is, or is becoming, a national menace in almost every country in the world outside north-western Europe. In some countries governments are fully alive to the danger and are actively co-operating with the people on the land to check it; in others the seriousness of the position is recognized officially, but governments are debarred by economic, political or social factors from enforcing effective control measures; only in a very few is the government indifferent, and in still fewer is indifference justified. Soil erosion is a world-wide symptom of the present maladjustment between agricultural systems based mainly on the European model and the various conditions of soils and climate—very different from those of Western Europe—prevailing in the New World. European agriculture is suited for a humid, temperate climate; when its principles are applied to semi-arid regions like the American and Australian plains, or to the tropics, disastrous soil erosion occurs. In many countries the continuous loss of topsoil over immense areas is the most serious problem that the user of the land has to face. The position is one of the utmost gravity in the United States and in South and East Africa.

To find means of checking erosion is not entirely a matter for the agricultural scientist and the engineer. Erosion can be permanently checked only by ensuring that the right use is made of the land. Methods for checking erosion, and correct ways of utilizing land so that erosion will not occur, are now quite well known. In the main they involve taking commonsense, inexpensive precautions to ensure that rain water is absorbed where it falls on to the soil and does not run off the surface, carrying soil with it, or to ensure that dry soils are not exposed to winds. But such precautions have not hitherto been taken in semi-arid regions, and their general adoption would mean a revolution in agriculture which would profoundly affect not only the farmers

but the great industrial centres of the world which depend for much of their food on the produce of the semi-arid prairies and steppes. Hence the soil-erosion expert, when he attempts to get his commonsense measures adopted, encounters not only the universal conservatism of the farmer but also a powerful but intangible resistance from distant cities and lands. At this point the work of the agricultural or forest expert in erosion control ceases and the task taken over by the economist.

The practical soil-erosion expert—or "soil conservationist" —has contributed little that is really new to agriculture. The prevention of soil erosion was the basis of early agriculture in semi-arid lands and led, for example, to the development of the vast systems of flat terraces that can still be seen on the hills of North China, Peru and the Philippine Islands. The fundamental principle of erosion control is the same to-day as it was in olden times, namely, to check the velocity and therefore the eroding power of run-off water. But the old, flat "bench" terraces which made a slope look like a steep staircase, are entirely unsuitable for large-scale mechanized farming, and one of the soil conservationist's main achievements has been to develop an efficient terrace adapted to modern conditions. The modern terrace, which is almost indispensable on sloping cultivated land in semi-arid regions, consists of a broad-based, low mound of earth usually constructed along the contour so that it is dead level. These terraces are very efficient in preventing erosion; both they and the spaces between them can be cultivated, and they do not interfere with mechanical operations. In fact, they facilitate the adoption of the so-called "contour farming"—i.e. carrying out as many operations as possible on natural levels, even at the expense of the straight-line cultivation that used to be the ploughman's pride. The most dangerous cultivation of all is up and down a slope. This allows rain water to pour down the furrows, tearing away the soil as it goes; the safest cultivation is on the contour levels, so that water is held in the furrows and has time to be absorbed by the soil.

A type of contour farming now very widely practised in the United States to prevent erosion is strip cropping. Alternate strips of clean-cultivated crops like maize and close-growing crops like grass are laid out on the natural contours of a slope, the close-growing strips acting in much the same way as contour terraces in catching run-off water and soil washed down from the exposed, clean-cultivated strips. The strips are rotated so that each part of the slope in turn gets the protection of a close-growing crop, which not only serves to hold up water and soil washed down from above but also helps to build up an erosion-resisting, crumb-structure in the soil.

The principal direct causes of this now world-wide soil

erosion are deforestation (particularly on watersheds), overgrazing and prolonged cultivation of sloping land. The remedies are obvious; to reserve watershed areas for forests; to limit stocking to the safe carrying capacity of the land; to rotate soil-conserving crops like grass and clover with arable crops. The difficulty is to arrange things so that these simple remedies can be applied. In South Africa, for example, the principle watershed areas are in native reserves, where every acre of land is required for agriculture. In East Africa the reduction of the livestock population to the safe carrying capacity of the already badly eroded land is, for social reasons, quite impracticable. The safe stocking level of many Australian pastures is below that at which the farmer can sustain himself. Continuous cultivation of wheat, maize, cotton and tobacco is already a firmly established tradition, which cannot easily be broken, in North America. These are examples of the real difficulties encountered in stopping the present appalling destruction of the world's most fertile lands. There are now few technical difficulties in checking erosion. The means are ready to hand; the problem is to apply them.

All over the world people are beginning to take stock of the position and to see the problem of soil erosion in its true light. The Soil Bureau's publication sets out the facts, as far as they are known, about the extent of erosion throughout the world, the circumstances that have produced it, and the measures that have so far been taken, by a small band of practical and scientific workers, to cope with a situation without parallel in history..

India.—The Report on the work of the Imperial Council of Agricultural Research in applying science to Crop Production in India, by E. J. Russell, has now been published (Ref. 105). The material for this Report was obtained during a long and detailed tour of inspection during the winter 1936-7 and it covers all the important regions and crops of India excepting cotton and jute, which come within the purview of organisations other than the Council.

There is an extensive literature on Indian Agricultural Science and practice which can be found in the Bulletins of the Imperial Council of Agricultural Research: in its Journal (Indian Journal of Agricultural Science); in the Memoirs of the Indian Academy of Science and elsewhere. The Council also has a periodical, "Current Science," for the publication of short articles or of preliminary announcements.

Reference can here be made only to two of these investigations.

Tea in Northern India.—The general work of the Tocklai Tea Research Institute was described in the last report (p. 235):

a summary has now been published by the chief scientific officer, P. H. Carpenter (Ref. 106).

The two essential conditions for the successful production of tea are an acid condition of the soil (in N.E. India pH 5·8 or less on a sandy soil, 5·2 or less on a clay soil, and 4·8 or less on a peat soil) and an abundant supply of nitrogenous manure of which sulphate of ammonia appears to be by far the best. Cattle manure is nothing like as good. Over a period of 4 years at Tocklai an annual application of 5 tons of cattle manure per acre, supplying 60 lb. of nitrogen, gave an increase of 765 lb. of tea, while the same quantity of nitrogen as sulphate of ammonia gave an increase of 1,580 lb. of tea per acre. Similar results have been obtained in other experiments, indicating that, for the same application of nitrogen, cattle manure possesses about one-half to one-third the efficiency of sulphate of ammonia. It is sometimes claimed that cattle manure is slow-acting and that its effect will be felt over a large number of years. This is not so: one application of 20 tons per acre of cattle manure, containing 160 lb. of nitrogen, produced a crop-increase over 4 years, but for no longer. An equal quantity of nitrogen as sulphate of ammonia gave about double the increase in crop over the same period of time.

Nitrogenous manures seem to give an increase in crop proportional to the amount of nitrogen supplied:

Nitrogen applied annually (lb. per acre).	Average annual gain in crop (lb. per acre).
40	256
80	535
120	721

The quantity of tea produced per lb. of nitrogen applied ranges from $4\frac{1}{2}$ to $6\frac{1}{2}$ lb. when the nitrogen is given in 40 lb. dressings.

Phosphates have little effect on yield, but bring about a slight improvement in quality. Potassic fertilizers cause no increase in yield; in some places they improve the quantity, in others they rather lower it.

Grazing in India.—As is well known, Dr. P. E. Lander (Ref. 107) of the Lyallpur Agricultural College has been for some years engaged in studying the fodder crops and the pastures of the Punjab and he has now published his analytical data and summarised his general results. As the paper deals rather with animal nutrition than with soil problems it is not summarised here, but I mention it because of its wealth of detail in regard to Indian fodder crops and grasses.

South Africa: High Veld pastures.—Experiments by T. D. Hall and Dr. Meredith (Ref. 108) on the manuring of High Veld pastures in South Africa has shown that here, as elsewhere,

nitrogenous fertilizers increase growth, while phosphatic fertilizers increase palatability; but that, as in many other very sunny countries, potassic fertilizers usually have but little effect. As elsewhere, also, the method of grazing is very important, and rotational grazing increased the carrying capacity even of unmanured land.

Citrus fruits in Southern Rhodesia.—A summary of the problems associated with the cultivation of citrus fruits in Southern Rhodesia has been published by W. J. Hall (Ref. 109). Of these, oranges and grape fruit are the most important. The old practice of green manuring is now superseded by compost (modified Adco process) made from river reeds, grass, sunn hemp, wheat straw, etc., and from the orange waste obtained after the cull fruit has been passed through the by-products factory. Basin irrigation is better than furrow irrigation. Fertilizers (200 lb. per acre) are applied in the irrigation water so as to ensure even distribution: part is given in winter (July) so as to ensure adequate plant food at blossoming time, and the rest in September, after the fruit has been picked but well in advance of the wet season (October and November). Nitrogen plays the most important part in maintaining tree vigour, high production, and good colour in fruit. Phosphorus is instrumental in setting heavy blossom and in improving the juice-percentage and the ratio of soluble solids to acid in the mature fruit. Potash, on the other hand, does not bring about a significant increase in soluble solids, but somewhat increases the percentage of acid in the juice. No treatment materially affected the fruit-size of the bulk of the crop, although the percentage of smaller fruit increased under high-nitrogen conditions, and the proportion of large and therefore potentially coarse fruit is greater under low-nitrogen conditions (Ref. 110).

A disease known as "hard fruit" has caused a good deal of trouble and has of late become a major problem. The leaves come small, with diminutive indentations on the ventral surface and the branches die back to a greater or lesser degree. In severe cases the bulk of the crop is shed in October and November and the fruits remaining are hard, and suffer from arrested development, malformation, the presence of gum pockets and a diminished juice-content.

The disease has now been traced to a deficiency of boron and it is remedied by the addition of borax to the soil (Ref. 111).

Russia.—Two papers on the agriculture of Russia have been published by E. J. Russell, the material for which was collected in a series of agricultural journeys in 1930, 1934 and 1937, a period of important change and development in Russia, particularly in connection with collectivisation (Ref. 112).

Germany.—In Germany the four-year plan requires a considerable increase in the home production of food and in a semi-popular bulletin (Ref. 113), Dr. Jacob points out that this means more fertilizers better used. Farmyard manure, he points out, is the natural basis of manuring, but there is never enough of this, and consequently artificial manures must be used. How great a difference they make is shown by comparing the yields in 1872, before artificial fertilizers were common in Germany, with those in 1933 when large quantities were used.

—	1872.	1933.
Rye, cwt. per acre	7·5	15·4
Potatoes, tons per acre	3·2	6·1

Many people, however, fear that artificial fertilizers have given this increase in crop at the expense of quality, supposing that food grown on organic manures has somehow better nutritional value than that grown with artificial manures. Dr. Jacob can find no evidence for this: in this he agrees with English workers.

China.—An extensive survey of the agriculture of China has been carried out by Prof. J. L. Buck (Ref. 114). It was planned and administered by the Department of Agricultural Economics of the University of Nanking and it gives perhaps the most detailed account now available of the utilisation of land in China. The northern region is devoted to wheat and the southern to rice; grassland forms only about 1 per cent. of the total farmland but actual areas vary from 0·3 per cent. in the spring wheat area to 12·2 per cent. in the Szechwan rice area. The two most serious problems of the country are floods and soil erosion: the two great rivers, the Yellow River in the north and the Yangtze-kiang, while they make the fertile provinces, can also destroy them. The great interest of Chinese agriculture lies in its permanence and the methods by which this has been attained have always attracted agricultural students.

Japan.—In a recent bulletin of the Utsunomiya Agricultural College (Ref. 115) Dr. Isobé points out that Japanese agriculture is dominated by the extremely hilly nature of the land: three-quarters of it has a slope of more than 15°, i.e. 1 in 4 and, therefore, is not suited for cultivation but only for forest, and the amount of land that can be used for arable purposes is only about 15 per cent. of the total: this is much less than in any western country, even including Great Britain. The area of grassland is even less than that of arable, and more than half the area is wood

and forest. The comparison with Great Britain is, in millions of acres :—

—	Total area.	Arable land.	Permanent grass and pasture.	Wood and forest.	Other land.
Japan . .	95·6	15·0	8·1	51·1	21·1
Gt. Britain . .	56·8	12·1	17·3	3·2	24·2

Although Japan has nearly double the area of Great Britain, it has only three million acres more arable and less than half the acreage of grassland. The farms are extremely small : one-third are one acre or less : another third are below 2½ acres and an additional one-fifth are below 5 acres—leaving very little for larger farms. By far the most important crop is rice which occupies half the arable area, while wheat, barley and oats added together occupy about one-quarter. The farmers, especially the smaller men, are mostly tenants; only about one-third are owners, and these cultivate about half the arable land. The problems of Japanese agriculture differ entirely from those of the Western Countries, but they have some resemblance to problems in parts of the British Empire, and so the Reports of the Experiment Stations are always likely to be of value to British agricultural experts (Ref. 116).

Rubber in Malaya.—W. B. Haines has now followed up his important work on the manuring of rubber trees (Ref. 117), with another paper (Ref. 118) in which he describes a sampling method for recording yields. This has improved the reliability of experimental results by eliminating some of the human sources of error, and so increases the amount of information given by the experiments. The new results have led to a revision of some of the conclusions of the earlier paper : it was there stated that nitrogen is usually the only element required by the rubber tree : it now appears that, in one at any rate of the sets of experiments, the complete fertilizer was significantly superior to nitrogen alone.

Holland.—A very interesting account of the reclamation of the Dutch Polders has been prepared by J. G. Bijl (Ref. 119) for the International Geographical Congress held at Amsterdam in July 1938. It gives probably the best modern account of the subject and can be recommended to all who are interested in land reclamation.

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PESTS AND PARASITES.

INTRODUCTION.

In the chapter on the pests and parasites of farm crops that appeared in the "Farmer's Guide" for 1932, the effect on research of the prevailing economic conditions in the agricultural industry was pointed out. Pests can seldom be controlled without the expenditure of money, and with crops of low value such expenses must be correspondingly small; this fact greatly increases the investigator's difficulties in finding a remedy. Next, when the financial returns from any crop are poor, the grower naturally turns to others that offer better prospects, and this change leads the research worker to concentrate his attention on the problems of those crops that are of immediate importance to the industry; thus in the years prior to 1932, economic conditions tended to encourage the growing of certain crops such as sugar beet, fruit and vegetables, at the expense of the cereals and roots for stock feeding, formerly the standby of the arable farm, and the research reported on the last occasion reflected this change. During the succeeding period the influence of economic conditions has been no less marked. The trend to more specialised crops has continued, and the insistent demands for research have come from the growers of these crops—fruit, for instance, and notably sugar beet: indeed, within the past five or six years more work has been done on the troubles of beet than was ever carried out during the many years when the mangold crop comprised nearly all the beet grown in Great Britain.

Even more important, however, is the fact that economic conditions have brought into prominence a set of problems that are new, or at all events have not had to be faced in recent times. These new difficulties have arisen from the reduction in the number of paying crops that have been available to the farmer in the difficult post-war period, and the consequent need to grow any and every crop at as small a cost as possible. In consequence, the farmer with land well suited to a certain crop—potatoes, for instance—has planted potatoes far more frequently on that land than formerly, while the cereal grower, by

mechanisation where conditions permit, has cut his costs, but again at the expense of growing straw crops more often. Thus the principles of rotation that have so largely governed British agriculture for the past hundred years have to some extent been abandoned, with the inevitable result that certain pests, notably soil pests, have so increased as to become a very serious menace. Most prominent among these pests is a species of eelworm that first attracted serious attention when it attacked potatoes and became known as the Potato Eelworm. Other races of the same eelworm attack beet, causing Beet Sickness, oats, peas and cruciferous plants like cabbage and turnips. Indeed, there would seem to be few, if any, crops to which a race of this destructive pest will not become adapted, whenever it is given the opportunity; this opportunity is provided whenever susceptible crops are grown frequently on the same land. When it is remembered that, on heavily infested land, such crops can be taken only once every five to seven years, it will be realised how alarming the position may become. The Root Eelworm is taken only as an instance, admittedly the most serious instance, of the difficulties from pests that result from the frequent growing of a particular crop on the same land. The Stem Eelworm (the kind that causes Clover Sickness and Tulip Root of oats) is also encouraged by this procedure; and insect enemies, no less, tend to increase when they find abundant food in the same place each successive year. Research workers are giving great attention to the problem of dealing with these different soil pests and reference will be found in the succeeding pages to some of the results. It would, however, be idle to suggest that the complete solution will easily or speedily be found. The rotation of crops has been the one successful measure for meeting such trouble in the past, and the importance that rotation farming has assumed in England must have been, at least in part, due to this fact.

Little further is necessary by way of introduction. The different sections are presented on much the same plan as before; that on the parasites of farm animals is omitted as being rather within the scope of another chapter; that on fruit is perhaps rather shorter, a fact due, in part at all events, to the progress made by the research worker in controlling fruit pests, so that the fruit-grower is now in a strong position compared with that of some years ago. Strawberries are indeed an exception, and here there is still very much to be accomplished before the position can be regarded as satisfactory. On the whole, however, the control of plant pests is being placed on a much surer foundation and, after the long period of neglect from which it formerly suffered, is now taking its proper place among the agricultural sciences.

Cereal Crops.

Winter Thinning.—During recent years research work on the pests of cereal crops seems to have been concerned mainly with insects associated with "winter killing" or "winter thinning." The gradual thinning of the crops during the period from November to April is apparent in most seasons, but once tillering begins in the spring the normal winter losses tend to be obscured and forgotten. It is only when the thinning of the crop is so severe that it fails in patches that attention is drawn to the losses. Investigations show that the insects causing these abnormal losses vary from field to field and from season to season, but it is clear that there is a very considerable variety of insects feeding simultaneously on the cereal crops during the critical months of winter and early spring. Under normal conditions no single species may cause perceptible loss but the total loss, from all the species concerned, is a steady drain on the health and vigour of the plants. On light and sandy soils in East Anglia Petherbridge and Thomas record such heavy losses from Mud Beetles that re-seeding has been necessary, and the same observers have found caterpillers of the Rustic Moth devastating cereal crops in the vicinity of grassland, or after ley has been ploughed for corn. Again, the Wheat Bulb Fly is associated with the killing of wheat following a potato or root crop that has left the soil largely uncovered during the late summer and early autumn, and the observations of Thomas at Cambridge show that three other species of flies cause similar injury to cereals and cultivated grasses during the winter and early spring. In their investigations at Warburton, Cheshire, Miles and Cohen have found that wireworms attack seed wheat shortly after sowing and that they may destroy as much as five per cent. of the seed; they destroy five to ten per cent. of the seedlings by the end of November and, during February, March and April they destroy a further five to ten per cent. of the tillers. The problem of checking the losses caused by attack on cereals during the winter months has not yet been studied as a whole. Measures to protect crops from the depredations of winter-feeding insects, and to reduce the losses from their attacks, are likely to include the selection of resistant varieties or of varieties with high power of recovery from attack, the adoption of pre-seeding cultivations to reduce the likelihood of insect infestation, and the use of suitable manures to promote early tillering. A study of rotational systems may be necessary in order to avoid crop sequences that encourage outbreaks of injurious insects, and to prevent the building up of excessive populations of pests. This matter of crop rotation is greatly complicated by the development and extension of mechanised

farming and the subsidising of wheat production, with their consequent tendency to short intervals between successive cereal crops. The treatment of seed prior to drilling may afford some protection from direct loss in the early stages of growth. McMillan and Hanley have found that drilling superphosphate with barley seed prevented wireworm attack, and Miles and Cohen are investigating the protection of seed with naphthalene. (Ref. 1, 9).

Mud Beetles. In Norfolk, Cambridgeshire, Lincolnshire and Suffolk mud beetles have been found causing extensive injury to wheat during the winter months. This insect had not previously been recognized as a serious pest although its occurrence on wheat had been recorded from Yorkshire, Lincolnshire and Cambridgeshire, and allied species, the turnip mud beetles, are known to be frequently injurious to turnips and other *Brassicae.* The injury is caused by the grubs, which feed at the roots of seedling wheat from late autumn to early spring. The grubs gnaw through the roots or tunnel into the stem and destroy the central shoot. They are difficult to find in the soil since they measure less than a quarter of an inch in length and are brownish and generally covered with particles of soil. In practically all cases of serious injury to wheat by these mud beetles the soil was light and sandy, and the tilth so loose that the plants were not tillering or forming secondary roots freely. The cropping of the previous year seemed to affect infestation, injury being most severe after ryegrass and clover, after sainfoin and occasionally after wheat; after potatoes, sugar beet and beans, injury was negligible, even though it might be severe in adjoining fields, or in portions of the same field that had carried a different crop. Date of sowing of wheat seemed to have some effect on the intensity of infestation since parts of the same field under the same sequence of crops, but sown with wheat on different dates, showed different degrees of injury; attack was negligible on wheat sown during the first week in October and very severe on that sown in the first week of December (Ref. 2).

Rustic Moth. From time to time winter cereals are badly attacked by caterpillars, and in 1934 Petherbridge and Thomas found serious outbreaks of caterpillars of the Rustic Moth on winter wheat in Cambridgeshire. Normally these caterpillars feed in the stems of grasses. When wheat is attacked, the caterpillars crawl downwards, between the sheathing leaves and the central shoot, to a position near the soil level where they begin to feed. In the course of feeding the central shoot is severed from the plant about three-quarters of an inch above the ground. Barley and rye may also be attacked. The causes of these outbreaks of Noctuid caterpillars are not yet understood.

Attack on cereal crops is frequently associated with the ploughing up of ley prior to drilling with cereals or with the occurrence of grassy droves or grassland adjoining the cereal crops. There is little doubt that the caterpillar population of grassland varies greatly from year to year, and caterpillar attack on cereals may occur when, either through especially favourable conditions of weather and food supply, or through some serious reduction of parasites and predators, the numbers of caterpillars are abnormally high. The observations of Barnes and Mercer suggest that the presence of Rustic Moth caterpillers may affect the quality of hay. Mercer in Northern Ireland has for some years noted injury to the flower heads of Meadow Foxtail, and Barnes has found similar injury to Meadow Foxtail in Hertfordshire. Investigation showed that the damage was caused by the feeding of Rustic Moth caterpillars on the panicle while it was still enclosed in the leaf sheath. It is not known if this type of injury occurs in some seasons only, or whether it occurs generally and is supplementary to the usual destruction of the shoots (Ref. 3, 4).

Frit Fly. As a result of work on Frit Fly carried out by several investigators it has become a widespread practice to avoid attack by sowing winter oats instead of spring oats, or by sowing spring oats early in the season. This method of reducing loss from Frit Fly is, however, not always possible because, except for the new variety "Resistance," winter oats may be badly affected by frosts, while inclement weather in spring, or the late removal of a winter crop, may prevent the early sowing of spring oats. In investigating resistance to Frit Fly attack Cunliffe has found that certain Swedish oats are highly resistant. By crossing these with standard English varieties he has bred strains of oats that have well developed resistance to Frit Fly attack, along with such qualities as good standing power of straw, good yielding qualities, low percentage of husk and early maturity. The factors determining resistance to attack have not yet been established, but the more resistant strains had higher percentages of total carbohydrate and of crude fibre. The large percentage of crude fibre may mean that resistant strains possess smaller cells, thicker cell walls or more fibrous tissue than non-resistant strains; such characters would make the penetration of the shoots by the maggots of the Frit Fly more difficult. Although the work is not yet complete it has progressed so far that a new variety of oat with well marked resistance to Frit Fly attack is being tested on a commercial scale (Ref. 5).

Dipterous Maggots Attacking Winter Cereals. The gradual thinning of winter wheat and other winter cereals by insect and allied pests is a phenomenon that frequently gives farmers considerable anxiety. Frit fly, wire-worms, leatherjackets, wheat

bulb fly and slugs are known to play an important part in depleting the cereal crops during the winter, and Dr. I. Thomas has now published studies of the life histories of a series of three species of flies whose maggots are found at the roots of cereals and grasses. These species will feed and develop on several cereal crops and on cultivated grasses. The part played by each in attacks on crops and meadow grasses in this country is not defined, but on the Continent they appear to be of considerable economic importance. The life histories of the three species differ greatly. In one species adults are on the wing from June to November and eggs are laid in the autumn on the soil near sprouting wheat; these eggs, however, do not hatch until April; egg-laying is concentrated, therefore, on wheat sown early in the autumn and hence early-sown wheat is most heavily infested. In a second species the insects are on the wing from June to November; egg-laying begins in September and the eggs are deposited mainly on the stems of susceptible plants; hatching occurs in about a fortnight and the maggots of this species feed through the winter. In a third species there appear to be two generations a year and adults are on the wing from early in March to the end of November; maggots of this species may be found feeding throughout the year. The nature of the injury to the crops is the same for all three species. The young maggots find their way between the outer sheaths and the central shoots of the plants, finally boring into the shoot near the base and destroying it. While no one of these species of injurious maggots may itself be of sufficient importance to warrant control measures specially directed against it, the cumulative effect of the several agents causing "winter killing" makes this a major problem of cereal production (Ref. 6, 7, 8).

Potatoes.

For a variety of reasons considerable attention has been paid to the potato crop during the last few years, and research into several important potato troubles has produced interesting and valuable results. With increased knowledge of the nature of virus diseases, and of how they are spread, has come the possibility of raising and maintaining virus-free potato stocks. Such stocks are now being produced both experimentally and commercially in several parts of the country. The enhanced value of the potato crop and the improvements in marketing brought about by the activities of the Potato Marketing Board and its staff of field officers have resulted in greater attention being paid to the occurrence of blemishes in the tubers, and this in turn has revealed the widespread injury and loss caused by wireworms. Greater attention to yield per acre has resulted in the realization that poor yields, resulting from infestation by

potato root eelworm, are more common than has been generally supposed. Investigations on these two pests have therefore been initiated or extended. Potato root eelworm is now being studied at widely diverse centres throughout the British Isles, and a special field station has been established at Warburton, Cheshire, under the auspices of Manchester University, to study the wireworm problem. The danger of the introduction of the Colorado Potato Beetle from the Continent continues to be imminent, and entomologists in this country are watching with keen interest the experimental work on the control of this insect which is going on in France and the neighbouring countries.

Colorado Potato Beetle.—The outbreaks of Colorado Potato Beetle at Tilbury in 1933, and at Tilbury and Gravesend in 1934, drew attention to the need for all farmers and growers, particularly in the sea-board counties and in the vicinity of seaports, to be constantly on the watch for the presence of this insect in their crops. No further outbreaks of the beetles have occurred, and it is evident that the measures taken were completely successful in eradicating the pest. The possibility of beetles flying across the Channel, or of their reaching this country on ships, increases yearly with the spread of the insect in Europe. That the Channel would not be too wide for the pest to fly across is shown by observations in France where, in the Dept. of Creuse, they flew for 30 miles; again the sudden arrival of the insects in the Vosges suggests that they must have migrated for something like 250 miles. Climatic conditions in most European countries are suitable for the development of Colorado Beetle, and its spread seems to be limited only by the vigilance of the phytopathological services in the countries where it has been found and by the efficiency of the measures used to combat outbreaks.

The proximity of the Beetle to Britain renders investigations in France, by Feytaud and his colleagues, of special interest to us. Copper and aluminium arsenates have been found to be almost as toxic as lead arsenate when the applications contain an equal amount of arsenic pentoxide (As_2O_5); magnesium arsenate is even more toxic. Legislative restrictions on the use of lead arsenate have led to the use of barium fluosilicate, but in field trials arsenical dusts have generally given better results. Dusts containing 18 per cent. derris powder (minimum rotenone content 6 per cent.) and 25 per cent. pyrethrum (minimum pyrethrin content 6 per cent.) have also been used. Fine dusts are found to be more toxic than coarse dusts; they are effective with a smaller proportion of insecticidal substance, and their spreading power is greater. Dusts seem to destroy adult beetles more readily than sprays, but, they do not adhere so well to the leaves. Experiments with trap crops like petunia, salpiglossis and various species of *Solanum* to attract adults for egg-

laying are being carried out but not, apparently, with much hope of success. The breeding of resistant strains of potato is also under investigation. It has been found that Colorado Beetle infests equally the early, mid-season and main-crop potatoes, and that the degree of infestation depends largely on the development of the plants at the time of the spring migration and egg-laying of the beetles; plants at least 6 inches high and not more than 20 days old are preferred for egg-laying. Apparently the insect requires rapidly growing foliage and it has been suggested by Prince that the occurrence of a second brood is dependent upon such foliage being available. The part played by weather conditions, bacteria, fungi, insect and other parasites and predators in limiting the increase of the beetles is being studied. Parasites and predators from America, the home of the Colorado Beetle, are being shipped to France for breeding and observation, with a view to ascertaining their suitability for establishment in France. A carabid beetle (*Lebia grandis* Hentz) has been liberated, while two predaceous Pentatomid bugs (*Perilloides* (*Perilla*) *bioculatus* F. and *Podisus maculiventris* Say.) and two parasitic Tachinid flies (*Doryphorophaga aberrans* Tns. and *D. doryphorae* Riley) are being reared. (Ref. 10 to 18; 41, 42).

Potato Aphides and Virus Diseases.—In the *Farmer's Guide* for 1932 an account was given of the early stages of the work by Davies and others at Bangor in connexion with a scheme for the production of seed potatoes in North Wales. During the period under review the work has made good progress and a number of important discoveries have been made regarding the source of aphides, the factors influencing their movement, and the conditions under which virus diseases are spread in the crop. It has been confirmed that the Peach Aphis is mainly responsible for the spread of "leaf-roll" and other virus diseases in the potato crop. In North Wales it was considered that peaches and nectarines were a negligible source of this aphis, and unsuccessful efforts were made to find it on allied plants, notably hawthorn, sloe, rose and plum. During the winter of 1931 Davies had occasion to examine a quantity of savoys and found vast numbers of Peach Aphides on the backs of the leaves; later observations verified that winter crucifers including cabbage, swedes, rape, savoys and cruciferous weeds attracted and sheltered Peach Aphides during the winter and spring. Winter crucifers, particularly savoys, are especially suited to the needs of the aphides: they do not wilt in frosty weather, and under very unfavourable weather conditions they afford shelter to the aphides in the folds and crinkles of their leaves. In the spring these hibernating wingless forms give rise to winged migrants that reach the potato crop in the period from the end of May

to the beginning of July. Early work had shown that while Peach Aphides occurred at all the centres where the production of seed potatoes was being investigated, the aphis migrants were as much as forty times more numerous at "unsuccessful" centres than at "successful" centres. The reactions of aphides to atmospheric moisture and to wind velocities have been studied under controlled conditions in the laboratory. It was found that at a temperature of 55°F. aphides were sluggish and rarely took wing whatever the degree of humidity. At a temperature of 70°F. the aphides were active and flew readily at relative humidities of 0, 25 and 50 per cent.; but, as the atmospheric moisture was increased to 70, 85 and 100 per cent. relative humidity, flight was greatly retarded. At a temperature of 80°F. and relative humidities of up to 50 per cent. the aphides readily took flight, but further increases in atmospheric moisture retarded flight, until at a relative humidity of 85 per cent., flight practically ceased. Wind, too, has an important effect on the activity of aphides. We have become accustomed to think (without very much exact evidence on the point) of insects flying to new feeding grounds down wind. When Peach Aphides were exposed to winds of any velocity above 4 miles per hour they remained practically stationary and as the winds were increased to gale force, small pads between the claws of the feet were used to enable the aphides to grip tightly to the surfaces on which they were resting. The aphides took flight only during calm conditions or in very light breezes.

These investigations have served to indicate some of the conditions under which seed potatoes may be grown successfully. In selecting a site it is necessary to take into consideration the cropping of the surrounding districts, for the presence of crops of winter crucifers is a potential danger to the production of healthy "seed." It is certainly worthy of note that in most of the districts where potatoes for ware production are grown extensively, cruciferous crops have also an important place in the system of culture; in Lancashire, particularly, cabbage and cauliflower are planted between rows of early potatoes prior to lifting them by hand. The close juxtaposition of these two crops ensures the Peach Aphides suitable host plants for the whole year, and provides a reservoir of virus carriers for each succeeding crop of potatoes. Weather conditions have an important influence on the incidence of virus diseases and need consideration in selecting sites for seed production. Places with a high relative humidity during June and July, when aphides migrate to potatoes, will tend to be less heavily infested, and the aphides present will be less likely to move freely from plant to plant while feeding. Crops in situations exposed to strong winds during the growing season

will deteriorate less rapidly than crops in sheltered places where light, dry winds encourage aphis activity.

The ease with which Peach Aphides find potato plants was demonstrated by planting isolated potatoes at intervals in other crops and at varying distances from fields of potatoes. Aphides were present on almost all the plants by the time they were six inches high, although main crops of potatoes in one instance were a quarter of a mile away. This, of course, complicates the problem of producing virus-free seed.

The problem of limiting the spread of virus disease in potato crops has been studied at the South-Eastern Agricultural College. In many districts spraying with Bordeaux Mixture (10 : 15 : 100) for the control of Blight is routine practice. The addition of a contact insecticide for the control of aphides would, if practicable, increase the value of the spray while adding nothing to the labour costs of applying it. Experiments showed that nicotine and pyrethrum extract, emulsified with either cotton-seed oil or concentrated sulphite lye, could be added to the usual Bordeaux Mixture without impairing its efficiency for blight control or resulting in injury to the potato foliage. "Seed" saved from crops sprayed for two seasons with these modified Bordeaux Mixtures showed significantly less deterioration through virus diseases than "seed" saved from unsprayed crops.

In this connexion it may be of interest to refer to American observations that potato crops sprayed with Bordeaux Mixture alone are more attractive to a certain species of potato aphis than those that have not been treated. It would seem that the attraction is not due to the colour of treated crops, but more probably to the fact that they reflect more light—*i.e.*, are brighter. If it is found that Bordeaux-sprayed potatoes are also more attractive to aphides in this country, it would seem that this treatment may actually increase the spread of virus diseases in the crop unless an insecticide is also used. (Ref. 19 to 24, 43).

Wireworms and Potatoes. Since 1933 wireworm injury has been fairly widespread and attention has been directed to heavy losses to the potato crop. Observations on the habits of wireworms show that there are two fairly well defined feeding periods, a spring period lasting through April and May and an autumn period lasting through September and October. At other times of the year the wireworms tend to descend to some depth in the soil, though some may be found, throughout the year, feeding near the surface. During the spring feeding period the wireworms attack the sets, sometimes honeycombing them with tunnels and injuring the bases of the sprouts and shoots. Attack on the new tubers is usually associated with the autumn feeding period but may begin in July and continue until November, or until the potatoes are lifted. Many of the wireworms tunnel

deeply into the potatoes and are removed with them to the clamps, where feeding continues. At present only a few tentative suggestions for reducing wireworm injury are offered. It is recognized that when non-humified organic matter is abundant in the soil wireworms do not depend entirely on crops for their food; thus when grassland or ley is ploughed up comparatively little injury occurs during the first year under cultivation. This suggests that, when numbers of wireworms are known to be present, the amount of non-humified organic matter should be maintained at a high level by heavy applications of farmyard manure or by ploughing in specially cultivated crops such as mustard, vetches or lupins. Mid-season varieties should, wherever possible, be substituted for main-crop potatoes since there appears to be a steady increase in loss from wireworms during September and October. Where main-crop varieties are grown the tops might be destroyed by spraying with sulphuric acid in order to hasten ripening and permit early lifting. Since wireworms in land under stubble approach the surface to feed in autumn, skim ploughing of stubbles, as soon as possible after the removal of harvest, is recommended; this should be followed by frequent cultivations and harrowings to expose the wireworms to the attacks of birds and to disturb pupae and overwintering adults (Ref. 25).

Potato Sickness and Root Eelworm. The importance of eelworms as a factor influencing plant health becomes more widely recognized each year as new districts and new crops are found to be seriously affected. Experiments by Carroll in Ireland have shown that Potato Root Eelworm is a primary cause of "potato sickness," and this despite numbers of recorded cases of good yields of potatoes on eelworm-infested land; but the intensity of the disease does not necessarily increase with increases in the number of cysts. It is now accepted that satisfactory crops can be produced on "sick" land by the application of stimulating nitrogenous dressings in order to increase root action and promote plant growth; but after an artificially stimulated crop has been produced the cyst content of the soil is greater than before, and subsequent potato crops may suffer severely from eelworm disease. In various parts of the country dressings of calcium cyanamide have been used to ensure a crop on "potato-sick" land. Investigations at the Institute of Agricultural Parasitology have shown that calcium cyanamide, during its decomposition in the soil, gives off fumes which are toxic to eggs and to young eelworms within the cysts; the greater the concentration of these fumes the more toxic they are. Light dressings of calcium cyanamide have only a slight and temporary effect on the hatching of eelworms in the soil and, by stimulating potato plants to vigorous growth, they generally serve to increase the

eelworm population. Heavy dressings of at least 30 cwt. of calcium cyanamide per acre, thoroughly incorporated with the soil, have a more deleterious effect on eelworms; the subsequent potato crop is practically unaffected and hardly any new cysts are added to the soil. Such dressings, however, upset the nitrogen-potash-phosphate balance in the soil and may have a serious adverse effect on the growth of potatoes. Pot experiments have shown that cabbages may be grown the first season after heavy dressings of calcium cyanamide, in order to utilize the excessive nitrogen, and that the roots of potatoes grown the second season are as free from cysts as those grown in similarly treated soil the first season after treatment; this procedure, however, has not yet been tested under field conditions. L. R. Johnson of Leeds University has used mercuric chloride against eelworms with some success. He applied the chemical as a solution and also as a powder lightly raked into the surface soil, the latter method being better suited for use on a field scale. Potatoes grown in treated soil made better growth, and produced higher yields, than those grown in untreated soil, and though all the plants ultimately became infested with eelworms, those in treated soil were only slightly infested and had few cysts on the roots. When applied three weeks before planting the mercuric chloride had a retarding effect on the early growth of the plants; the variety "Great Scot" was able to recover from this initial set-back as the summer advanced, but "Eclipse" lagged behind all the season. When applied three to four months before planting mercuric chloride did not retard growth, but eelworm infestation of the plants was much greater than when it was applied three weeks before planting. Laboratory experiments showed that mercuric chloride delayed the emergence of eelworms from the cysts but did not kill them.

Work on finding plants capable of stimulating the hatching of eelworms has been continued. Smooth-stalked meadow grass, rough-stalked meadow grass, ryegrass and maize have been found to stimulate the emergence of eelworms from the cysts. It has been discovered, however, that these minute, free eelworms can live for at least nine months in exposed soil that is kept clear of weeds and crops, and that they are able to survive both winter conditions and the dry warm conditions of early summer. In sheltered situations they are capable of living for at least 16 months. This probably explains the failure of mustard to protect the subsequent potato crop despite the fact that mustard stimulates the emergence of eelworms from the cysts. What happens to these free eelworms in the absence of a potato crop is not known, but it seems likely that some proportion of them find their way to other host plants. It is clear that crops which aim at artificially stimulating the emergence of eelworms from

the cysts must be grown at least one year before it is intended to produce potatoes.

An observation made by Robertson in Scotland is interesting as offering the suggestion that some varieties of potatoes may be more resistant to, or tolerant of, eelworm infestation than others. It is already recognized that in some districts eelworm disease affects main-crop more seriously than early varieties, and it has been assumed that, because the early varieties were sprouted before planting, they became well established before the main eelworm emergence took place. At Craibstone Experimental Station early potatoes gave very poor yields in eelworm-infested soils, while late potatoes generally produced a greater weight of tubers. From a survey of the yields of eight varieties for a period of seven years Dr. Robertson suggests that varieties like "Epicure" and "Kerr's Pink" which form their tubers rapidly (or, to use the grower's phrase, "bulk" early) are less affected by eelworm disease than varieties like "Duke of York" and "Sharpe's Express" that have least ability to bulk early (Ref. 26 to 39).

Stem Eelworm and Rot in Potatoes in Clamps. The extensive rotting of potatoes in clamps is frequently a sign of infestation by Stem Eelworm, a pest associated with disease in a wide range of plants, including oats, bulbs and clover. E. E. Edwards finds that strains of this eelworm are highly specialized, and records that on farms where the rotation was potatoes, cereals and clover (all very susceptible crops) only the potato crop was infested. Widening the rotation is recommedned as the best method of dealing with attack on potatoes. An interval of four years between potato crops is suggested, though in some cases satisfactory crops have been obtained after a rest of three years. Diseased crops should be carefully lifted so as to remove all tubers from the soil, since eelworm-infested tubers will maintain the disease from one season to another. The Stem Eelworm is spread mainly on "seed," so that it is important to plant only clean healthy tubers (Ref. 40).

Pests of Root, Pulse, and Vegetable Crops.

The volume of research work that has been carried out during recent years on the control of insect pests of root crops and vegetables is an indication of an important trend in British agriculture—namely, the widespread and increasing production of direct money-making crops, *e.g.*, sugar beet and such market-garden produce as cabbages, cauliflowers, celery, lettuce, carrots and onions. Already it is apparent that, while it is enabling farmers to carry on through difficult times, this new type of agriculture is attended by definite risks and responsibilities. The success that has attended individual or local enterprise has

encouraged the intensive production of certain crops in well defined areas. It is readily noticed that, as specialized crop production becomes predominant in an area, the insect and other pests of the crops concerned become abundant, and constitute a formidable menace threatening the crops anew each year. Under these conditions routine control measures become increasingly necessary and urgent. Certain treatments already available lend themselves to routine usage on a considerable scale: dressing and steeping seed, dipping plants prior to setting out, treatment of seed beds to provide pest-free plants for large-scale planting, and the periodic application of insecticidal dusts. But many of the needs of farmers and growers for large-scale crop production are not yet satisfied. Measures suitable for the control of root flies, such as the Carrot and Cabbage Root Flies, on large acreages are not available though it seems probable that the increased attention given to insecticidal and repellent dusts will enable these to be used with beneficial results, especially when their application is carefully timed to suit conditions in each locality. An interesting indication of modern tendencies in pest control is the condition in sugar beet contracts that the crop should not be grown continuously on the same land, viz., no beet after beet. This stipulation has been introduced in order to control the development of "Beet Sickness" due to eelworm, and to reduce the losses from attack by Pygmy Mangold Beetle. In his account of investigations on the Cabbage Aphis, which is one of the most serious pests of *Brassicae*, F. R. Petherbridge suggests that legislation might be introduced to restrict the production of seed crops of *Brassicae* to alternate years; this would do much to reduce the damage caused by this insect.

Beet Eelworm. The discovery of Beet Eelworm in the eastern counties in 1934 has added yet another problem to the many that confront the phytopathologist. Beet Eelworm and Beet Sickness have been known in Europe and America for many years, and are now present in East Anglia in numbers of fields that have been cropped with beet and mangolds for several years in succession. The eelworm associated with "beet sickness" is closely allied to that associated with "potato sickness," but according to our present knowledge the two strains are distinct: the beet eelworm cannot develop on potato crops nor the potato root eelworm on beet crops. In the absence of suitable crops the beet eelworms remain in a dormant condition within cysts. The presence of a growing beet crop stimulates the hatching and emergence of the eelworms which enter the roots of beet to feed and develop. Males remain worm-like, but as females reach maturity they become thick and swollen and protrude from the root tissue. The bodies of the females or

"cysts" fill with eggs, and the skin turns from white to brown and becomes a tough protective covering. Cysts of the beet eelworm are lemon-shaped and measure up to a sixteenth of an inch in length; well grown cysts contain 600–800 eggs. The first sign of beet sickness is the presence of patches of small plants in the crop. The outer leaves of these plants wilt in the sun and later turn yellow and die, and the heart leaves are undersized and numerous. The plants are easily pulled out of the soil and have small tap-roots, with excessive growth of lateral roots known as "hunger roots." As Beet Sickness develops and intensifies, the patches increase in size and the beet on them becomes valueless. There is, as yet, no practical treatment for eradicating the disease once it has become established, so that it is impossible to over-emphasise the importance of preventing its occurrence. Widening the rotation by increasing the period between beet crops helps to prevent the development of the disease and to alleviate its intensity where it already occurs. The disease is spread by soil and plants from contaminated fields, on tools, boots, farm carts and crops, and in manure made in yards where infested mangolds have been fed to stock. There is considerable evidence that turnips, swedes and other cruciferous crops act as alternate hosts for the beet eelworm ; these crops should therefore not be grown in the intervals between beet crops on land known to be infested with beet eelworms (Refs. 68, 69).

Cabbage Aphis. For some years F. R. Petherbridge and his colleagues have been studying the Cabbage Aphis. They find that the aphis normally spends the winter in the egg stage on the stems and lower leaves of brussels sprouts, autumn and winter cabbage and cauliflower; occasionally, in mild winters, colonies of adults persist through the year. The eggs hatch from February onwards and the young aphides travel to the growing shoots of the host plants where large colonies may be produced. From the middle of May until August winged migrants are produced and these infest new crops. Since the main source of infestation in the eastern counties appears to be *Brassicae* grown for seed, it is suggested that these crops be sprayed during the second or third week of May with a nicotine spray (3 oz. nicotine in 40 gals. water with a suitable spreader) or dusted with a 3 per cent nicotine dust. A second application may be necessary if aphis colonies are present on the flower heads after the first treatment. All old brussels sprouts, broccoli, cabbage and other *Brassicae* should be ploughed under, or pulled up, placed in heaps and burnt, not later than the middle of May. Heavily infested plants in fields of brussels sprouts or other *Brassicae* should be carefully lifted, put into bags and destroyed or treated thoroughly with some insecticide.

Seed-beds should be kept as far as possible from crops of the previous winter (Ref. 44, 45).

Pygmy Mangold Beetle. Outbreaks of the Pygmy Mangold Beetle have demonstrated how easily certain noxious insects can become serious pests when the well-established rules of agricultural practice are neglected. Extensive injury by the Pygmy Mangold Beetle has occurred in various parts of the country on land that has been cropped with sugar beet or mangolds for several years in succession. The beetles are very small—less than a tenth of an inch in length—and are present in such enormous numbers in badly infested fields that they cause the complete failure of the crop. They attack the germinating seeds, the roots of the seedlings, the leaves and the crowns of the plants. It was soon apparent that the chief cause of the vast numbers of these beetles was the abundance of food provided for them by continuous cropping with susceptible crops. By 1935 the beetles had become one of the worst insect pests of sugar beet, and attacks made necessary re-drilling on a large scale. As a result of investigations into this pest and the Beet eelworm it is now realised that sugar beet should not be grown on land that has produced the same crop in the previous year. Where this precaution is taken damage by Pygmy Mangold Beetle is reduced to small proportions. It still, indeed, occurs where sugar beet and mangolds are grown in successive years, because the two crops are closely related and are equally attractive to the beetles. The ease and speed with which this pest has been brought under control by rotational cropping shows how important a part "good husbandry" plays in maintaining the balance between the crops and the animals parasitic upon them (Ref. 46, 47).

Cabbage Flea Beetle. This flea beetle has been found barking the stems of cabbage, a type of injury not previously recorded in this country. In Derbyshire, where the insect caused serious injury in 1935 and 1936, dusts containing barium silicate, and arsenical sprays, were used to protect crops from the adults, while it was necessary to plough in cabbages that were badly infested by the larvae (Ref. 50).

Cabbage Root Fly. In recent years demonstrations have been carried out in various parts of the country to show that Cabbage Root Fly can be readily controlled by applications of corrosive sublimate (mercuric chloride) solution of a strength of 1 oz. in 8 gal. of water. About $\frac{1}{4}$ pt. of the solution is applied to each plant three times, at ten-day intervals beginning three days after setting out. This method is effective and reliable, but it is not likely to be used extensively on a field scale because the solution is very poisonous and the methods of applying it are laborious and costly. E. E. Edwards has experimented with other substances. Commercial naphthalene powder sprinkled

round the plants gave satisfactory protection in some seasons, but weather and soil conditions seem to affect the results. Some measure of control followed the use of weak tar distillate wash and a solution of magnesium sulphate or "cattle salts." The tar distillate wash was that used for winter spraying in fruit plantations and it was used at a concentration of 1 fluid ounce in $1\frac{1}{2}$ gal. of water; 4 fluid oz. of the solution was applied to each plant three times, with ten-day intervals, the treatment beginning on the day of transplanting. The magnesium sulphate, at a concentration of $1\frac{1}{4}$ oz. per gallon of water, and at one pint of solution per plant, was also applied three times at intervals of ten days, beginning at the time of setting out. An interesting observation made by Edwards associates intensity of infestation by Cabbage Root Maggot with the date of setting out. Plants set out the last week of June were much less seriously affected by maggots than those set out in May, probably because the peak of egg-laying was already past by the date of planting in June. American workers have also found naphthalene a promising substitute for mercuric compounds. Calomel (mercurous chloride), used as a seed dressing at the rate of 2 lb. calomel to 1 lb. seed, gives complete protection of seedlings in the early stages. Calomel and various oxides of mercury have been mixed with inert carriers, like gypsum and hydrated lime, to form a four-per-cent. dust, and two or three light applications at weekly intervals are recommended as giving a safe and effective control. Promising results are also said to have been obtained by rolling the plants, prior to setting, in twenty- to fifty-per cent. calomel dust until root and stems are well coated (Refs. 54 to 58).

Cabbage Stem Weevil. The Cabbage Stem Weevil is generally considered to be a minor pest of cruciferous crops in this country. In recent years, however, it has caused such serious injury to cabbage and cauliflower in Germany and other parts of North Europe that it now seems as important as the Cabbage Root Maggot with which it is often associated. Attention has recently been drawn to its potentialities as a pest by A. E. Cameron, who found it infesting swedes in South Scotland. The weevils leave their hibernation sites and feed on seedlings of cruciferous crops, sometimes seriously checking their growth. Eggs are laid in rows along the stalks of the leaves, a row of six to ten eggs on a stalk. The grubs feed in the stalks, causing the leaves to wilt and die, or to be broken off in the wind. Occasionally some grubs tunnel into the crown of the plant, where their feeding encourages the development of Soft Rot. Moisture seems to have an adverse effect on mature grubs and the weevils are less numerous after wet weather in the autumn and winter. The sheltered feeding habits of the larvae make control difficult. It is recommended in Germany that infested plants should be

thrown into copper sulphate solution, together with the infested stalks of plants that are marketable, in order to destroy the larvae. Arsenical sprays and derris or naphthalene dusts are suggested as likely to protect seedlings from attack by adults (Refs. 51, 52).

Cutworms. Cutworms or Surface Caterpillars have recently caused serious injury to sugar beet, carrots, celery and *Brassicae* in various parts of the country, and, since they can be readily controlled by poison baits, it seems opportune to review the nature and time of the injury and give formulae for suitable baits. The injury occurs mainly at two periods—in the spring (during May and June) on seedlings of sugar beet, mangolds, carrots, turnips, swedes, etc.; and in late summer and autumn on the established crops. The spring attack is usually more serious from the farmer's point of view, for a bad attack means the re-seeding of whole fields or parts of fields. The summer attack may mean much filling of gaps among newly-planted *Brassicae;* and loss of weight and quality in such crops as sugar beet, mangolds, carrots and potatoes. Observations at Cambridge in 1935 and 1936 suggested that the moths which give rise to cutworms might be attracted for oviposition to fields where there was a good deal of bare soil. Injury to sugar beet seedlings was most severe when beet followed carrots, celery or potatoes, and was negligible when beet followed corn. A bait giving satisfactory results at Cambridge consisted of 1 lb. Paris Green thoroughly mixed with 30 lb. bran and evenly moistened just sufficiently to enable the Paris Green to adhere to the bran. Sodium fluoride in the proportion of 1 lb. to 20 lb. of bran, with 1 lb. treacle, was also effective. It is suggested that farmers and growers, in districts where cutworms are regularly present, should look out for the first signs of cutworm attack and use poison baits immediately. They will thus avoid serious damage to seedlings, the expense of re-seeding and delay in getting the crops established (Ref. 53).

Carrot Fly. Workers in Northern Ireland have carried out experiments on the control of Carrot Fly and make the following recommendations:—(1) There should be suitable intervals between susceptible crops, so as to avoid building up excessive carrot fly populations. (2) Seed should be sown very thinly so as to avoid the necessity for thinning the plants; this operation intensifies the attraction of the crop for the flies and, by loosening the soil, makes it more suitable for oviposition. Dressings of naphthalene, applied to the seedlings just before or during weeding and thinning, serve to deter the flies from oviposition. The use of naphthalene dust to deter egg-laying, and of derris dust to destroy the flies when they seek the crop for oviposition, is recommended by other investigators (Refs. 60, 61, 62).

Leatherjackets. Paris Green and bran bait in the proportion of 1 in 30 continues to give satisfactory results at Wye. A German worker has used a special grade of finely ground Kainit at rates of about a third and a half of a ton per acre, and has found that such dressings destroyed practically 50 per cent. of the young leatherjackets (Refs. 65, 66).

Onion Fly. At the New York Experiment Station a calomel treatment of onion seed, for the protection of the onions against root maggots, has been carefully worked out and tested. D. W. Wright of the Horticultural Research Station at Cambridge has carried out experiments to test the efficacy of the treatment in this country and makes the following recommendations:—Make a dilute solution of 3 teaspoonfuls (14 grams) of adhesive paste (as purchased) in half a pint of water. (A suitable adhesive paste can be made at home with three teaspoonfuls of starch or flour in half a pint of water; this should be brought to the boil and allowed to cool before use.) The onion seed (1 lb.) should be put in a suitably sized container of glass, wood or enamel, since calomel tends to corrode metal. The prepared paste solution should be poured on the seed, and the mixture stirred until all the seeds are moistened, but not wet. Powdered calomel equal in weight to the seed is then added, and the whole mixed until the seeds are thoroughly coated with powder. The treated seed may be handled immediately, but can be allowed to dry without loss of the calomel. The seed-bed should be very firm, in order that few of the calomel-covered seed coats shall be carried above ground; it is the calomel on the seed coats at the bases of the plants that appears to be toxic to the root maggots (Refs. 56, 59).

Pea Moth. There is no known control method for this pest except to avoid sowing peas close to land on which an infested crop was grown during the previous year. It may be of interest to note that in parts of Washington, U.S.A., where peas are extensively grown for canning, the pest has become so serious that, in one county, the growing of all peas and vetches had to be prohibited for a year. There it was found that ¼ mile was insufficient distance from a field that had carried an infested crop in the previous year. A distance of 1½ miles was necessary (Ref. 71).

Slugs and Snails. The successful use of Metaldehyde for the control of slugs and snails has already had a good deal of publicity in horticultural journals. Experiments to test its efficiency have been carried out at the Pathological Laboratories of the Ministry of Agriculture and at the Harper Adams and South-Eastern Agricultural Colleges. There is no doubt that metaldehyde, the chief constituent of "Meta," is highly attractive to slugs and snails. The manner in which they are

affected by "Meta" has not been established, but Jary and Austin have found that slugs brought into contact with the chemical exuded quantities of slime and later became moribund. This probably prevents their regaining their usual shelter during the day, and they die from the combined effects of excessive slime exudation and exposure to sunlight. It is also probable that "Meta" is poisonous to slugs when ingested along with bran. "Meta" may be distributed about the surface of the soil in small pieces the size of peas and suitably protected from rain. These pieces continue to be attractive for several weeks—probably long enough for the slug population in their vicinity to be much depleted. The more usual method of using "Meta" is to grind it to a powder and mix it with dry or slightly moistened bran in the proportion of one stick of "Meta" (about 4 grains) to eight ounces of bran. This bait may be broadcast if the weather is favourable, or may be placed in little heaps, about a foot apart, each protected from rain by a raised tile; the heaps retain their attractiveness for some weeks. Woodlice and leatherjackets appear to be unaffected by "Meta," but reports suggest that domestic animals and birds may suffer if a bait is eaten in quantity. When the bait is placed in heaps, it should be covered by tiles or in some other way (Refs. 65, 67).

Stem Eelworm Disease in Field Beans. Stem Eelworm, which has already been referred to in connexion with the rotting of potatoes in clamps (p. 392), is also the cause of severe injury to field beans in Yorkshire. Edwards found that the potato-infesting strain was highly specialized and did not affect leguminous crops or oats grown on the same land. In Yorkshire, however, Johnson and Thompson have found that the strain of stem eelworms infesting oats can be transferred to field beans, and that a slight attack in the oat crop of one season may be followed in the next year by a severe attack upon beans. This complicates the problem of suitable rotation on eelworm-infested land for although beans occur regularly only once in four years, they usually follow oats in the rotation. Weeds, particularly cleavers (*Galium aparine*), act as alternate hosts of the stem eelworm, and the presence of volunteer bean plants (ground-keepers or "comers"), in the years immediately following the bean crop, helps to maintain the pest in the intervals between crops. The practice of ploughing in the remains of diseased crops should be avoided since it returns to the soil an increased eelworm population ready to attack either susceptible crops or weeds. It is recommended that all remains of infested crops should be carefully collected and burnt. Bean straw harvested from crops known to be infested with eelworm should also be burnt, since the eelworm can remain quiescent for a number of years in dried plant material (Ref. 70).

Swede Midge. Swede Midge has become an important pest of cabbage and cauliflower in Europe, its attacks being associated with bacterial rots which often render the crop unmarketable. Since the insect is common and widely distributed in Britain it must be regarded as a potential pest of these crops in this country. It may be of interest to know that Continental workers have found that the generations of midges occur at such remarkably regular dates that a spray calendar can be given for them. The second and third generations of the midges are the most injurious and can be controlled by three sprayings at six-day intervals during the second and third weeks of June and again during the second and third weeks of July. Nicotine and soft soap sprays are preferable to derris or pyrethrum (Refs. 63, 64).

Turnip Flea Beetles. The problem of Flea Beetle control in warm dry springs has always been a serious one for farmers and market growers. Promising fields of turnips and swedes have been devasted in a single day; or, if hot weather occurs when the seedlings are breaking the ground, they may be destroyed even before they appear. Seed-beds of cabbage, cauliflower and brussels sprouts are often similarly attacked. In the spring of 1934 the weather was especially favourable for Flea-Beetle attack and serious losses were reported from many parts of the country; both in the Cambridge and the North-western Province, however, it was demonstrated that cruciferous crops could be saved by the timely application of suitable dusts. At Cambridge the light derris dusts and nicotine (3 and 4 per cent.) dusts destroyed the beetles and allowed the crops to become established; in the North-west a dust of finely powdered naphthalene and silica safeguarded the crops by repelling the beetles. The dusts should be applied four or five days after seeding in order to prevent attack while the plants are still below the surface of the ground, and a second application of dust should be made as the plants appear. Other applications should be made at intervals of three to five days, according to the weather and the intensity of attack. The careful preparation of the land, so as to secure as fine a tilth as possible, assists in preventing attack in the early stages, and whenever the weather is favourable for attack the beds should be examined twice a day for the occurrence of beetles. Although the most satisfactory results have been obtained by anticipating injury, dusting after attack has begun may still save sufficient plants to render re-seeding unnecessary. There is now a wide range of suitable dusts on the market. A light dust should be selected because of its greater covering power, but the choice of derris, nicotine or naphthalene seems to be largely a matter of cost and convenience. The dusts are easily applied from a knapsack duster and under normal conditions two men can dust an acre

in an hour and a half. It is also possible to apply the dust, rapidly and efficiently, with certain types of manure distributors.

A second method of dealing with flea beetles, that of dressing the seed with repellent substances, has always been of a controversial nature; some farmers are convinced that it has saved their crops while others state that it has failed completely. The dressings most used in the past have been either paraffin (kerosene) or turpentine, and it would seem that, for either to prove effective, enough of the oil must remain on the seed-coat, or on the adjacent soil, either to repel the flea beetles or, by disguising the " smell " of the germinating seed, to prevent the pests from detecting the presence of the crop. On this assumption it should prove possible to discover some dressing more potent than kerosene or turpentine; Walton of Long Ashton has devised the following mixture which, in a considerable proportion of the tests but not in all, has proved effective :

Kerosene	1 gallon.
Paradichlorbenzene	4 lb.
Naphthalene	1 lb.

About one fluid ounce of this mixture is allowed for each pound of seed. The dressing is done the evening before sowing, the seed being left on sacking to dry overnight. The total cost for the ingredients of the dressing is said to have been 5*s*. 10*d*., equivalent to less than 2*d*. per acre; a practical trial is thus not an expensive matter (Refs. 48, 49, 72).

Wireworms and Sugar Beet. These pests are as destructive to sugar beet as they are to most other crops. Some years ago Petherbridge and Miles showed that the wireworms could be attracted to sprouting wheat and that, by treating the wheat rows with a soil fumigant, the pests could be killed. This treatment is satisfactory for small areas of land, but the use of the soil fumigant is often impossible on a field scale. Petherbridge, however, has found that even if no fumigant is used the beet crop can be protected by sowing wheat between the beet rows, the wireworms remaining at the roots of the wheat until the beet is beyond serious harm. In his experiments he sowed wheat at the rate of 40 lb. per acre between the beet rows and, although the wheat was completely destroyed by the wireworms, a good stand of beet was obtained. A somewhat similar treatment in which maize replaced wheat has been tried in Hungary, but in that case the maize plants were lifted and the wireworms found were destroyed. Incidentally, Petherbridge's experiments also showed that, in growing beet in wireworm-infested fields, heavier seeding of beet—20 lb. per acre instead of the more normal 15 lb.—is advisable (Ref. 73).

FRUIT.

When last a section on crop pests appeared in the *Farmer's Guide* (1932), research had led to the discovery of possible methods of dealing with a fair proportion of the more important pests of fruit, and the work of the subsequent period has been rather to elaborate the practical details of these methods under commercial conditions; special attention has been given to combinations of different insecticides and fungicides so as to relieve the fruit-grower's overloaded spray programme.

Again, much more attention has been paid to the spraying apparatus itself and to the organisation of the labour, so as to reduce as far as possible both the time taken in spraying and its cost.

The work on the combination of insecticides and fungicides is mentioned later (p. 410). Here, reference is confined to investigations relating to specific pests. These have been arranged in alphabetical order.

Cherry Fruit Moth. This pest, of which the caterpillars bore into cherries, seems to have attracted little attention recently, but it may be worth recording that it is said to have been effectively controlled on the Continent by a tar-distillate wash (Ref. 74). It has similarly been controlled in Kent (Ref. 93A).

Codling Moth. Notorious in many apple-growing countries, this insect is not, under normal conditions, so serious a menace to the English fruit-grower as it is elsewhere; but during the warm summers of 1934–35 it increased in numbers to such an alarming extent as to require immediate attention from entomologists in England. During the same period the pest was more destructive than usual on the Continent of Europe and, as a result, it has been closely investigated there as well as in Great Britain. The first result of these investigations was to remove a misconception rather widely current as to the period when the moth emerges and lays its eggs. From the insistence, in the Dominions and the United States, on the value of the "calyx" or first post-blossom spray as the foundation of any spray programme against Codling Moth, it has been assumed that, in this country, the moth appeared about the same time—*i.e.*, from the middle to the end of May. It was soon found (or rather rediscovered) that, in England, very few moths have emerged before the first week of June, and that the great proportion do not come out until after the middle of June—often about the 21st. A further discovery of practical importance was that the moths have a very extended period of emergence, some coming out as late in the year as August; hence first-brood caterpillars might be found in the fruit from June to the end of

August. Precisely similar observations were made near Paris, where in 1934 the emergence (from 1933 caterpillars) lasted from May 14th to August 1st. Previously it had been supposed that caterpillars found in the fruit in August must be those of a second brood, but it is evident that, in England at all events, a second brood of appreciable size occurs but rarely, and only in very warm years. A third discovery related to the mode of entry of the newly hatched caterpillar into the apple. It had been believed that those of the first brood almost all entered the fruit through the eye, or calyx (whence the need for the calyx spray), whereas those of the second brood were responsible for side entries. This assumption now appears to be incorrect: with apples at least, a large proportion of side entries may be due to first-brood caterpillars, and the value of the calyx spray may be thus reduced. The weather conditions in 1936 brought the Codling Moth population more nearly to normal, and the period of abnormal abundance did not last for long enough to enable the experimenter to assess the exact importance of the calyx spray; the experiments, however, tend to suggest (1) that the value of this spray should not be underestimated—*i.e.*, a single spray applied just after blossoming gave a better control than might have been anticipated from the number of side entries observed; (2) that, in periods when the moth is abundant, lead arsenate (or some other arsenate) should be included in post-blossom applications of lime sulphur up to July 1st. (Owing to the arsenical residue danger, later applications of lead arsenate should be avoided, at least with early varieties.)

Finally, it may be noted that the observations tended to support those made in the United States and elsewhere that the Codling Moth requires for egg-laying calm evenings with a temperature of 60° Fahr. or over; the frequency of such conditions in June and early July will give some idea as to whether the insect is likely to prove harmful or not (Refs. 75, 76, 77).

Plum Sawfly. This pest, which may cause a serious reduction in the plum crop, especially with the variety Czar and to some extent with Victoria, has been under investigation at Cambridge, Long Ashton and East Malling. The first discovery was that the insect had in the past been wrongly identified as *Hoplocampa fulvicornis* and that it was really another species, *Hoplocampa flava.* The point is not of direct practical importance, but is mentioned here in case growers should be puzzled by the fact that earlier writers on pest control—*e.g.*, Theobald—refer to the insect under the former name.

With regard to control measures, experiments have been carried out both on the Continent of Europe and in this country. The treatments tested followed more or less those that have proved successful against Apple Sawfly; in addition, however,

the old-fashioned insecticide, quassia, was included. The results were of much interest, in that it was found, both abroad and at Cambridge, that quassia and soap gave excellent results. Both the Cambridge and Long Ashton investigators found that derris, with a mineral oil emulsion, was nearly as good, while derris and soap gave an adequate control in East Malling. Derris with sulphonated lorol was, on the other hand, definitely inferior, while nicotine and lead arsenate were relatively ineffective. Further points that emerged from the Cambridge experiments were that the derris and mineral oil combination gave a useful control of red spider and thrips, which latter pest is sometimes responsible for much scarring of the surface of plums.

The successful spray applications were made when the "cots" of the plums were beginning to split and the final recommendations from the Cambridge work are (1) that, for the control of Plum Sawfly alone, a wash of the following formula should be applied at this time :—

Quassia	12 lb.
Soft soap	1 lb.
Water	40 gallons.

(The quassia chips should be soaked in the soap solution for at least 24 hours.)

(2) Where red spider and thrips have also to be dealt with, then the above wash should be replaced by one consisting of :—

Mineral oil emulsion	3½ pints.
Derris	12 oz.
Water	40 gallons.

(Refs. 78, 79, 80).

Raspberry Beetle. Reference was made in the 1932 *Guide* to the East Malling work which led to the use of Derris as the control for this pest. To complete the story, it may now be recorded that further experiments showed that one application of derris and soap is all that is necessary for raspberries, loganberries and cultivated blackberries. The spray should be applied to raspberries about three weeks after the beginning of blossoming; logans may be treated at the same time as the raspberries, while blackberries should be sprayed a fortnight later. In each case the correct time for spraying is when the Raspberry Beetle larvae have just begun to attack the earlier berries. Dusting earlier in the season to destroy the adult beetle did not everywhere prove satisfactory (Ref. 81).

Strawberry Aphis. The proof at East Malling that this insect is responsible for carrying the "Yellow Edge" virus from plant to plant has placed it in the first rank as a strawberry pest, and much painstaking work has been carried out both at East Malling and Reading to discover its life history. The important points would seem to be (*a*) that the insect can exist in cultivated

strawberry plants throughout the year; (*b*) that, at two periods of the year, viz., the end of May or early June and in the autumn, colonies contain winged aphides in abundance, and that, during the spring period at all events, the pests fly freely; (*c*) that while the insect can live on Silver Weed and perhaps other wild plants, there seems to be no general migration—such, for instance, as takes place with the Mealy Plum Aphis—from strawberries to wild plants; (*d*) that the wingless aphides crawl freely from plant to plant in the field.

The deductions from the grower's point of view are :—

(1) It is very important to rogue out all "Yellow Edge" plants in a young plantation, since even a small percentage of such plants are likely to spread the disease through the medium of crawling aphides.

(2) Disease from outside the plantation will be brought in at the periods of migration, and chiefly during the early summer migration if it be true that flight occurs less readily in the autumn. Something may be done, by spraying or dusting, to destroy the strawberry aphides, and attempts should obviously be directed specially to the control of new arrivals. Unfortunately the strawberry is a most difficult plant to treat satisfactorily either by spraying or dusting, and the investigators are attempting to find a new method of applying insecticides—*e.g.*, by atomization (Refs. 82, 83).

Strawberry Weevils. The Strawberry Blossom Weevil, known in some districts as the "Elephant" Fly, has been under investigation at Reading, Botley and Wye, derris dusts having been tested as an alternative to the arsenical insecticides, which cannot be used with safety on strawberry fruit. Unfortunately, the results have not been sufficiently good, and the work is still in progress. The problem is a difficult one and it may be of interest to note that no success has been obtained in Canada, where a closely allied species of weevil damages the blossom buds in exactly the same way. A result of the Botley work, which is of possible importance, relates to the presence of such weevils as the Vine Weevil in strawberry plantations. The larvae of these weevils may occur in numbers at the roots of strawberries and may either kill the plants or render them very sickly. The weevils cannot fly and, if the land is not infested when the plantation is made, they must crawl in from outside. These results offer another reason for advising (1) that strawberries should be planted only in land that has been under clean cultivation with some crop such as potatoes for at least a year; (2) that new plantations should not be made by planting narrow strips of land interspersed between strips of old plants—a method which enables pests on the old plants immediately to infect the new.

For land that is already overrun by Vine Weevil, tests are being made of various poison baits that have been claimed to give considerable control over a similar species in the U.S.A. In Oregon, the bait advised consists of bran 50 lb., water 4½ gallons, sugar 10 lb., calcium arsenate 5 lb. One application is given at blossoming, and—more important—one after the crop is picked, the rate of application being from 33 to 100 lb. per acre, scattered round the base of the plants (Refs. 84, 85, 86, 87).

Tortrix Moths. With the increased attention to grading and also to the storage of apples before sale, the damage done by the caterpillars of certain "tortrix" moths has become of greater importance. Previously these pests had attracted attention chiefly by their attacks on foliage, but latterly injury to mature fruit has become appreciable. This latter is caused by the young larvae which hatch from the eggs towards the end of summer and before going into winter quarters feed for a time partly on the leaves but also on the skin of the apple, notably when they chance to be taken into the store with the fruit. Investigations at East Malling have shown that the species chiefly responsible is the "Bell" tortrix, so-called because when it is at rest the outline of the wings forms the shape of a bell. This is a very abundant species that feeds on a great variety of plants and not only on fruit trees. It would be exceedingly difficult to reduce its numbers appreciably even if we knew of an effective method of dealing with it on fruit trees. The advice of the Malling Station is to place the apples, as soon as possible, in cold store, preferably in a suitable gas mixture. This prevents damage and causes the death of a considerable proportion of the caterpillars (Refs. 88, 89).

Woolly Aphis. Although there is some difference of opinion as to the amount of damage that this pest causes in an established plantation where a normal routine programme of spraying is carried out, there is no doubt that it is everywhere a nuisance, and that on young stock it is injurious.

Experiments carried out at Long Ashton, on the treatment of young stock prior to planting, showed that fair results (85 per cent. clean) were obtained by dipping the stock, roots and all, in a 10 per cent. tar-distillate wash. No damage whatever was done to the trees, but the aphides were not quite eradicated. A definitely better control (98 per cent. clean) was given by immersing the stock in water at 110° Fahr. for 30 minutes. This is on the lines of the well-known bulb treatment. Again, no harm was done and the trees grew with remarkable vigour. East Malling results agree with those at Long Ashton in respect of the safety of dipping stock in 10 per cent. tar-distillate, the plants being on type IX and XVI. It was also found that

fumigation with hydrogen cyanide, using 4, 8, 16, and even 32 oz. of sodium cyanide per 1,000 cubic feet of space in the fumigation chamber, caused no harm to the stock.

While referring to Woolly Aphis, some reference may be made to its parasite *Aphelinus mali.* This insect, originally distributed in England by the Ministry's laboratory at Harpenden, has given very variable results as a control for Woolly Aphis. A typical case is reported from East Malling in which the parasite gave relatively poor results the first year, and so the grower decided to spray twice the next year. After the spraying had been carried out it was found that the parasite had in fact increased to such an extent that most of the aphides had been killed by it. Fortunately, it would appear that contact insecticides applied in summer, when the parasite is in the pupal stage inside the aphis, have practically no effect on it. An Australian investigator finds that it was unharmed by a miscible white oil at 1 : 40, by nicotine sulphate 1 : 600 with soap, and by lime sulphur 1 : 35 (Refs. 90 to 93).

Insecticides and Spraying.

Within the last few years, both in this country and overseas, and especially in the United States, great attention has been paid by research workers to insecticides. The object has been partly the discovery of new chemicals with valuable insecticidal properties but partly also to get better standardisation of materials already known or, by the addition of new wetting substances, now sometimes known as "spray supplements," to find better combinations of insecticides and fungicides. Considerable progress has been made in the discovery of potential new insecticides, and it is now clear that this type of work is likely to prove of great practical value. A period of time, however, must elapse between the detection in the laboratory of the useful properties of a certain chemical and its production on a factory scale and at an economic price; until this stage is reached it is of little direct interest to the farmer or grower; there is thus no justification for any detailed reference here to much of the work that has been done, a point that is made to explain the relative brevity of this section as compared with the very large number of research papers that have been published.

As indicating the lines on which work is proceeding, reference may be made to two groups of chemicals that find rather frequent reference in scientific journals. In the first place, extensive experimental work has been done with the thiocyanates of certain fatty alcohols, which have valuable properties as contact insecticides or ovicides and appear to be relatively non-poisonous from the human point of view. The one most generally referred

to is lauryl rhodanate; this would seem to be already coming into practical use in the United States as, for instance, in fly sprays. It has been shown at Long Ashton to have ovicidal properties comparable with those of a tar-distillate and, being a "pure chemical," its use would involve no difficulties in standardisation. Whether it, or any of the other aliphatic thiocyanates, will be brought within the range of the farmer or fruitgrower is still uncertain (Ref. 94).

Another line of work has had its origin in the realisation that fruit subjected to frequent spraying with arsenical washes (as is necessary where Codling Moth is a serious pest) often retains more arsenic when it is sent to the market than is permissible from the health standpoint. What is required here is an internal poison that is, like lead arsenate, insoluble in water, but which is non-toxic, or nearly enough non-toxic, to those who may eat traces of it on the fruit. Nicotine possesses some of the qualities required since, when diluted to the extent usual in spray fluids, it is much less dangerous than arsenic and still toxic to insects; but the pure substance is too volatile, while nicotine sulphate (the other form in which it is commercially available) is too easily washed away and lost to be of service against Codling moth. The investigators have therefore tested other compounds of nicotine, and two—nicotine tannate and nicotine "peat" (*i.e.*, nicotine combined with the natural organic acids in peat)—have been found to possess some of the properties needed; they have already been used in field trials, but again it is not yet decided whether they will be of practical value to the English fruit-grower. The two lines of work, however, exemplify what is going on in many directions—viz., the testing of chemicals that have not previously been known to have insecticidal properties and the production of well known insecticides in new combinations to meet special purposes (Refs. 94, 95, 96).

Rotenone Insecticides. Reference was made in the 1932 *Guide* to the value of "Derris" insecticides. These are now so well known that little need be added, except to say that supplies of rotenone-containing insecticides have since been greatly augmented by the importations of "Barbasco," the product of a different plant (*Lonchocarpus*) from South America. From the research point of view the problem of standardising these rotenone-containing insecticides is still not fully solved, and the introduction of "Barbasco" has not rendered the matter any easier; it would seem that the comparative values of different samples of Derris and Barbasco cannot be judged entirely by the standard of rotenone content (Ref. 97).

Another standard by which the value of these insecticides is sometimes estimated is by the "total ether extract"; this also, however, is unsatisfactory, since non-toxic as well as toxic

substances may be extracted by ether. In default of better standards, however, it would seem that the purchaser who buys on chemical analysis (rather than on biological test) must value any sample by rotenone content, by total ether extract, or a combination of both. If rotenone is taken as the standard the Long Ashton investigators advise that the dilute wash when ready for use should contain 0·004 per cent. crystalline rotenone (raspberry beetle and plum sawfly being the pests to be dealt with).

Standardisation of tar-distillate and mineral oils. Since the introduction of washes made from these oils, and with the realisation of their great value in pest control, one of the most difficult problems presented to the research worker has been to find a satisfactory means of so standardising these washes as to enable the grower to obtain consistent results. Both tar-distillate and mineral oils are variable in composition, and not only consist of mixtures of different oils but also contain other substances. The oils themselves grade in toxicity from those which are more destructive to insects to those that are less, while again some are more liable than others to cause injury to plants. It is therefore not possible, as has sometimes been suggested, to pick out a single toxic ingredient and put this on the market as a pure chemical like nicotine; no one chemical in the mixture is solely responsible for its value. The question is still further complicated by the fact that the oils must form sufficiently stable emulsions with water and finally, must be of such a character as to fit in with the oil distillers' routine, since to him spraying oils are more or less a side-line.

The problem of standardisation is thus exceedingly complex, and it is satisfactory to record that considerable progress has now been made towards a solution. As a result of work done at Long Ashton and elsewhere, it is possible to specify with some degree of accuracy the types of oil, in tar distillate and mineral oil washes, that are desirable for use on dormant trees, and also those types of the latter which are desirable for application to foliage. The application of these specifications to the manufacturing side of the business is now under consideration by the makers, and there are reasonable grounds for hoping that it will shortly be possible to issue agreed standards on the lines of those already available for many of the more simple insecticides and fungicides.

To prevent misunderstanding, however, it should be noted that the adoption of such specifications would not tell the grower which is the best brand out of a number of reasonably good ones. What would be achieved is the elimination of ineffective or dangerous mixtures and of the failures due to their

use. Standardisation can never, of course, compensate for unfavourable weather conditions during spraying, or for the use of inefficient tackle and labour while, as regards damage to buds or foliage, it would seem that variations in the physiological condition of the trees as well as variations in the composition of the wash affect the issue. Further research in this direction is needed.

Combined washes. It is not so long ago that it was considered important to attempt to control no more than one kind of pest or disease by any particular spray application. Emphasis, for instance, was placed on the need for a fine misty spray of most fungicides, and for a coarse driving spray of a contact insecticide. In modern fruit-growing, and with the recognition of the importance of the exact timing of operations, it would be impossible to plan a spraying programme on these lines; the only solution is so to combine insecticides and fungicides as to control at each application as many different pests and diseases as possible. Investigations as to how this may best be done have been in progress at Long Ashton and East Malling for some years, and have had practical results which are now available to growers. It would take too much space to quote these results in full, and readers should refer to the annual reports of the two stations in question. As examples of the difficulties to be overcome, those relating to the apple, which needs the most complicated spraying programme, may be quoted. Here the chief problem is how to control Scab, Sawfly, Winter Moth, Codling Moth, and Red Spider, all of which may require to be dealt with between the time when the apple blossom is at the "pink bud" stage and that shortly after petal fall. Thus a fungicide, an internal poison, a contact insecticide, and an acaricide are all needed, and all within a very short space of time. The Long Ashton programme meets the difficulty by the use, firstly, of lime sulphur and lead arsenate at the pink bud stage (to control Scab and Winter Moth caterpillars); secondly, at petal fall, a wash containing nicotine, lead arsenate, and either a white oil emulsion or a proprietary spreader (to destroy Sawfly, Codling Moth and Winter Moth); and, thirdly, seven days later, a spray in which lime sulphur, nicotine, and a wetter are used to deal with red spider, and to continue the control of Scab and Sawfly. The programme used at East Malling Station is rather similar, but the lead arsenate to control caterpillar is included, with an earlier lime-sulphur spray, applied in the "green bud" instead of the "pink bud" stage. The petal-fall spray comprises lime sulphur and nicotine only, without any wetter, and the second post-blossom spray consists of lime sulphur alone. Strict comparison of these programmes would not, however, be fair, since the Long Ashton programme is for

use by West Country fruitgrowers generally, while the East Malling programme was designed to meet the particular conditions occurring in the East Malling plantations in the year in question when some pests—*e.g.*, Codling Moth—were known to be so scarce as to require no special treatment.

The two programmes will, however, show the difficulties of the apple grower, and the extent to which the combination of insecticides and fungicides has already been carried. From the research point of view the problem is to find chemicals that may be mixed without interaction, or with only such interaction as does not affect their properties; that will spread or penetrate in such a way as to kill the insects; and that will leave, when dry, a protective coating against the Scab fungus.

Much has been done to facilitate the use of mixtures of this sort by the introduction of new wetting and emulsifying reagents in place of soap. Many of these reagents, which are of a proprietary or semi-proprietary character, have been evolved in the first place for use in industrial rather than agricultural practice. The chief respect in which they score over soap is that they do not combine with lime and can thus be used as a wetter or emulsifier in lime sulphur or bordeaux mixture; moreover some, unlike soap, do not react with lead arsenate; mixtures containing lead arsenate, lime sulphur, nicotine and an oil emulsion thus become possible as washes for fruit trees (Refs. 99, 100).

J. C. F. Fryer.
H. W. Miles.

Scientific Names of Pests Referred to in this Chapter.

Apple Sawfly	*Hoplocampa testudinea Htg.*
Beet Root Eelworm	*Heterodera schachtii Schmidt.*
Bell Tortrix	*Tortrix podana Scrop.*
Cabbage Aphis	*Brevicoryne brassicae L.*
Cabbage Stem Flea Beetle	*Psylliodes chrysocephala L.*
Cabbage Root Maggot	*Chortophila brassicae Bche.*
Cabbage Stem Weevil	*Ceuthorrhynchus quadridens Panz.*
Carrot Fly	*Psila rosae F.*
Cherry Fruit Moth	*Argyresthia nitidella Fab.*
Codling Moth	*Cydia pomonella L.*
Colorado Beetle	*Leptinotarsa decemlineata Say.*
Cutworms	*Euxoa segetum, E. nigricans,* etc.
Frit Fly	*Oscinella frit L.*
Leather Jackets	*Tipula spp.*
Mud Beetles	*Helophorus spp.*

Onion Fly	*Hylemyia antiqua Meig.*
Pea Moth	*Cydia nigricana Steph.*
Peach Aphis	*Myzus persicae Sulz.*
Plum Sawfly	*Hoplocampa flava L.*
Potato Root Eelworm	*Heterodera schachtii Schmidt.*
Pygmy Mangold Beetle	*Atomaria linearis Steph.*
Raspberry Beetle	*Byturus tomentosus F.*
Rustic Moth	*Apamea secalis L.*
Stem Eelworm..	*Anguillulina dipsaci Kuhn.*
Strawberry Aphis	*Capitophorus fragariae Theob.*
Strawberry Blossom Weevil	*Anthonomus rubi Herbst.*
Swede Midge	*Contarinia nasturtii Kieff.*
Turnip Flea Beetles	*Phyllotreta spp.*
Vine Weevil	*Otiorrhynchus sulcatus F.*
Wheat Bulb Fly	*Hylemyia coarcata Fall.*
Winter Moths	*Cheimatobia brumata L.*
Wireworms	*Agriotes spp.* and other Elateridae.
Woolly Aphis	*Eriosoma lanigerum Hausm.*

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CONTEMPORARY AGRICULTURAL LAW.

[NOTE: This article covers a period of twelve months to the rising of Parliament and of the Courts for the summer vacation, 1938.]

THE year ending with the 31st July, 1938, has not seen any startling or fundamental changes in Agricultural Law. The legislature has, however, passed one or two Acts, as, for example, the Bacon Industry Act, 1938, and the Food and Drugs Act, 1938, which affect specific branches of the industry, namely, the production of bacon pigs and of milk.

Moreover, there have been several Acts (for example, the Road Haulage Wages Act, 1938, and the Holidays with Pay Act, 1938) which, whilst primarily applying to industrial trades, incidentally affect, and impose additional burdens on, agriculture.

The Courts have decided few important cases of agriculture.

I. LEGISLATION.

The primary object of the ROAD HAULAGE WAGES ACT, 1938, is to make provision for the proper remuneration of workers employed in the mechanical transport of goods by road. It is important to notice, however, that it has no application to (*a*) the drivers of motor vehicles which are operated under the agricultural preferential rate of Road Fund Duty, as, for instance, tractors, or (*b*) work in respect of which a minimum rate of wages has been fixed under any other enactment (e.g., the Agricultural Wages Act). It appears, therefore, that the wages of a man who is primarily an agricultural worker and drives a lorry only on occasion will not be affected. A summary of the provisions of the Act may, however, be of interest to farmers because it is believed that several hundred hold B licences and a very considerable number hold C licences. The work to which the Act applies is road haulage work in connection with any goods vehicle for which an A, B or C licence is required under the Road and Rail Traffic Act, 1933. The workers covered by the Act are known as " road haulage workers ", a term which is defined as meaning persons employed on all or any of the following work :—

(*a*) driving or assisting in the driving or control of a goods vehicle;
(*b*) collecting or loading goods to be carried in or on the vehicle;
(*c*) attending to goods while so carried;
(*d*) unloading or delivering goods after being so carried;
(*e*) acting as attendant to the vehicle;

and who are required to travel on or accompany the vehicle for the purpose of doing any such work.

A person who travels with a vehicle, however, mainly for the purpose of doing work other than road haulage work on arrival, is not within the definition, even though he takes part in loading and unloading.

Road haulage work in connection with vehicles operated under A and B licences is dealt with in Part I of the Act, which provides for the setting up of a body to be known as the Road Haulage Central Wages Board and of a number of Area Wages Boards. The duties of the Central Board will be :—

(*a*) to submit to the Minister of Labour proposals for fixing the remuneration to be paid to road haulage workers to whom this Part of the Act applies;

(*b*) to submit to any Government Department recommendations with respect to safety on the roads, the health and comfort of workers and any other matter affecting the efficiency of, and conditions of work in connection with, the transport of goods in vehicles operated under A or B licences; and

(*c*) to consider and report upon any matter referred to it by the Minister.

In performing these duties the Central Board will be assisted by the Area Boards concerned, to whom any draft proposals under (*a*) above must be submitted before transmission to the Minister. The proposals, if accepted by the Minister, will be given effect to by " road haulage wages orders " which will lay down the statutory remuneration to be paid to the various classes of workers.

Road haulage work in connection with vehicles operated under C licences is dealt with in Part II of the Act, which provides a method of fixing remuneration entirely different from that laid down in Part I.

If the remuneration of any worker employed in this class of work is considered unfair by himself or by any trade union of which he is a member or which, in the opinion of the Minister, represents a substantial number of workers employed in road haulage work, application may be made to the Minister requesting that the matter may be referred under this Part of the Act for settlement. Unless the Minister considers that the application is frivolous or vexatious, he will make representations to the employer of the man concerned, and the matter may then, of course, be settled by arrangement. If it is not settled in this way the Minister will refer it to the Industrial Court who may then fix the remuneration to be paid. If, in the particular industry, there exists a method of settling disputes by concilia-

tion or arbitration, this will be employed instead of the Industrial Court.

Remuneration will not in any event be deemed to be unfair if either :—

(*a*) it is equivalent to that which would have been payable under any road haulage wages order in respect of that work if the work had been in connection with vehicles operated under A or B licences, or

(*b*) it is in accordance with any agreement in force made between the employer, or any organisation of employers of which he is a member, and any trade union, or

(*c*) it is equivalent to the remuneration payable in respect of similar work in the same district in pursuance of an agreement made between an organisation representing a substantial number of employers and a trade union, or

(*d*) it is equivalent to the remuneration payable in respect of similar work in the same district in pursuance of a decision of a joint industrial council, conciliation board or other similar body, or

(*e*) it is equivalent to the remuneration payable in respect of similar work in the same district in pursuance of a decision of an Industrial Court.

An employer is bound to pay to a worker not less than the statutory remuneration, where such a rate is in force, and if he fails to do so, he renders himself liable to a fine not exceeding £20 for each offence. No deductions must be made except those authorised by the Unemployment Insurance Acts and the National Health Insurance Acts. An employer is also bound to keep records sufficient to show that the provisions of the Act are being complied with, and regulations as to the form to be taken by these records may be made by the Minister.

THE FINANCE ACT, 1938.—Section 29 provides that where the profits arising from lands occupied as nurseries or market gardens have, in pursuance of Rule 8 of the rules applicable to Schedule B, been estimated according to the provisions and rules applicable to Schedule D but assessed under Schedule B, an appeal against the assessment may be made to the Special Commissioners instead of to the General Commissioners. This right of appeal to the Special Commissioners has been granted because it was represented to the Government that there was a grave lack of consistency in the decisions of General Commissioners, who operate only locally. The majority of cases depend almost entirely on questions of fact, and the Courts have shown great reluctance to interfere with the Commissioners' findings on such questions. The Special Commissioners will, it is hoped, deal with all appeals coming before them on the same basis, and thus establish a degree of uniformity which is now

lacking. It is understood that the National Farmers' Union has interested itself deeply in the whole question, and members of that body who intend to appeal against an assessment under Rule 8 of Schedule B will be well advised first to communicate with the Union.

Section 52. A person liable to pay land tax may claim exemption if he produces a certificate that his income does not exceed £164 or £400 a year, the exemption being total in the first case, and as to half the tax in the second. Previously it was necessary to produce the certificate before the tax was paid, but it is now sufficient if it is produced before the expiration of twelve months after the end of the year in which the land tax became payable.

It has for some considerable time been notorious that the law relating to hire-purchase agreements left the way open for grave abuses. THE HIRE-PURCHASE ACT, 1938, improves the position to some extent, as will be seen from a perusal of its terms. There is, however, at least one matter of great importance which has not been dealt with, and it may be of interest if it is shortly discussed. A person who hires goods under a hire-purchase agreement does not become the owner of those goods and he is not entitled to sell them. It frequently happens, however, that he does sell them. The purchaser from him, who has bought in perfect good faith and given a fair price, has no title to the goods at all, and the true owner may recover them or their value from him. The purchaser has, it is true, a right of action against the hirer, but this is worthless in the majority of cases, for hirers who sell in this way nearly always turn out to be men of straw. My experience has been that this type of fraud is particularly common in the cattle trade and, although I know that it is more easily said than done, I would advise all intending purchasers of cattle to take the most careful inquiries as to whether they are the subject of a hire-purchase agreement. Strong representations, which unfortunately were not accepted, were made to the promoters of the Act, while it was passing through Parliament, to insert provisions which would remove this evil.

The Act applies to both hire-purchase agreements and credit-sale agreements, and it is necessary in the first place to define these and certain other terms which are given special meanings by the Act.

Definitions. A "hire-purchase agreement" is an agreement under which a person agrees to hire goods and to pay a number of instalments. At the end of a certain time, or after the payment of a fixed number of instalments, he has the option to

buy the goods at a pre-arranged price. Where there are a number of agreements, none of which can be regarded as being in itself a hire-purchase agreement but which in the aggregate constitute one, they are together deemed to be a hire-purchase agreement. A "credit-sale agreement" is an agreement for the sale of goods under which the purchase price is payable by five or more instalments.

It is important to notice that under a credit-sale agreement the goods become the property of the person who is paying for them as soon as the agreement is made, while under a hire-purchase agreement they do not become his property until he has exercised the option referred to above.

"Hire-purchase price" means the total sum payable by the hirer under a hire-purchase agreement in order to complete the purchase of goods to which the agreement relates, exclusive of any sum payable in respect of any breach of contract by him. "Owner" means the person who lets goods to a hirer under a hire-purchase agreement, or an assignee of such a person. "Hirer" means the person who takes goods from an owner under a hire-purchase agreement, or an assignee of such a person.

"Total purchase price" means the total sum payable by a buyer under a credit-sale agreement, exclusive of any sum payable in respect of any breach of the agreement by him.

"Livestock" means horses, cattle, sheep, goats, pigs or poultry.

Application of Act. The Act applies only to hire-purchase and credit-sale agreements where the hire-purchase price or total purchase price does not exceed—

(*a*) in the case of a motor vehicle, a railway wagon, or other railway rolling stock—£50;
(*b*) in the case of livestock—£500;
(*c*) in any other case—£100.

Requirements relating to hire-purchase agreements. A hire-purchase agreement, or any security given under it, is unenforceable unless the following conditions are complied with :—

(*a*) Before the agreement is made, the owner must state in writing to the hirer the price at which the goods may be purchased for cash. This condition is deemed to have been complied with if a label clearly showing the cash price is attached to the goods when they are inspected by the hirer, or, if he chooses them from a catalogue, the cash price is shown in the catalogue.
(*b*) A memorandum of the agreement must be signed by the hirer and all other parties to the agreement.

(*c*) The memorandum must state the following :—
- (i) the hire purchase price;
- (ii) the cash price;
- (iii) the amount of each of the instalments;
- (iv) the date or the mode of determining the date upon which each instalment is payable, and
- (v) a list of the goods sufficient to identify them.

(*d*) The memorandum must contain a notice, in the prescribed form, setting out the right of the hirer to terminate the agreement and the restrictions on the recovery of the goods by the owner.

(*e*) A copy of the memorandum must be given to the hirer within seven days after the agreement is made.

The Court may dispense with requirements (*c*) (*d*) and (*e*) if it considers that the hirer has not been prejudiced.

Requirements relating to credit-sale agreements, under which the purchase price exceeds five pounds, are similar to those necessary in the case of a hire-purchase agreement except that (*d*) is, of course, omitted.

Right of hirer to determine hire-purchase agreement. A hirer is entitled to determine an agreement at any time before the final instalment is due by giving written notice to that effect to the payee. He is then bound to pay such an amount as will bring up his total payments to half the hire-purchase price plus any installation charges specifically mentioned in the agreement. He must also make good any damage which the goods have suffered.

Avoidance of certain provisions. Any of the following provisions in a hire-purchase or credit-sale agreement is void :—

(1) A provision under which the owner is authorized or permitted to enter premises to remove goods.

(2) A provision taking away or prejudicing the hirer's right to determine the agreement.

(3) A provision under which any person acting on behalf of the owner (or seller) is deemed to be the agent of the hirer (or buyer).

(4) A provision under which the owner (or seller) is relieved from liability in respect of the acts or defaults of any person acting on his behalf.

Implied conditions and warranties. The following are to be implied in every hire-purchase agreement :—

(*a*) A warranty that the hirer shall have quiet possession of the goods.

(*b*) A condition that the owner will be able, when called upon in pursuance of the agreement to do so, to pass the property in the goods to the hirer.

(*c*) Except in the case of goods which are stated in the agreement to be secondhand, a condition that they are of merchantable quality. The hirer is not protected, however, against defects of which the owner could not reasonably be expected to be aware, nor, if he has inspected the goods, against defects which that inspection should have revealed.

(*d*) Where the hirer has expressly or by implication made known the purpose for which the goods are required, a condition that they are reasonably fit for that purpose.

Miscellaneous Provisions.

(1) The hirer or buyer is entitled, on giving four days notice, to be given particulars of the state of the account between him and the owner or seller.

(2) The hirer must keep goods comprised in a hire-purchase agreement in his possession or control, and, on request, inform the owner where they are.

(3) Where the hirer is paying instalments to the same owner under two or more hire-purchase agreements, he may appropriate any payment made by him to a particular one of the agreements.

(4) When one-third of the purchase price has been paid (plus any proper installation charges) the owner may recover possession of the goods only by action in the Courts. He may not seize the goods.

The Act will come into force on the 1st January, 1939, but provisions (3) and (4), immediately above, apply to hire-purchase agreements made before, as well as after, that date.

THE MILK (EXTENSION AND AMENDMENT) ACT, 1938, provides :—

(1) That the period for the making of payments out of the Exchequer in respect of milk sold or used for manufacture shall be extended until the 30th September, 1939.

(2) That a similar extension shall be made to the period during which payments may be made out of the Exchequer to Milk Marketing Boards in respect of expenses incurred by those Boards in giving effect to arrangements for increasing the demand for milk, and that the amount which may be expended in this way shall be increased from two million pounds to two and three-quarter million pounds.

The Housing (Rural Workers) Amendment Act, 1938, extends until the 30th September, 1942, the time during which application for assistance may be made under the principal Act of 1926. It also provides that payment need not always be made by way of a lump sum after the works have been completed but that, instead, payment may be made by instalments as the works progress. Not more than half of the total cost of the works may, however, be paid out in instalments in this way, the balance being paid, as before, after completion.

The rent chargeable in respect of a re-conditioned cottage may only slightly exceed the "normal agricultural rent." The definition of this term is changed by this Act, so that it now means the rent normally paid by agricultural workers in the district, or, if it appears to the local authority that the number of agricultural workers in the district is insufficient for the determination of any sum as being such rent as aforesaid, the rent normally paid by persons of substantially the same enonomic condition in the district.

Section 5 adds a further condition which must be observed in respect of a dwelling where assistance has been given by providing that all reasonable steps must be taken to secure the maintenance of the dwelling so that it shall be in all respects fit for habitation as a dwelling by persons of the working classes.

The remainder of the Act is concerned with the provisions as to the rents to be charged where further assistance is given or where the dwelling is let with other land, and with the assistance which may be given where it is necessary that alterations should be made in order that overcrowding may be avoided.

The Food and Drugs Act, 1938, which comes into force on 1st October, 1939, is in the main a consolidating measure. It repeals and re-enacts with certain amendments the following statutes among others: the Infectious Disease (Prevention) Act, 1890, the Public Health Act, 1908, the Milk and Dairies (Consolidation) Act, 1915, the Milk and Dairies (Amendment) Act, 1922, and the Food and Drugs (Adulteration) Act, 1928. It also amends a large number of other statutes.

In this article I do not propose to deal fully with that portion of the law which remains substantially unaltered, but to consider it only in so far as it is necessary to explain changes brought about by the Act.

Registration and Licensing.—The Act provides for registration and licensing of premises or persons in six cases. They are :—

(1) Registration of dairymen and dairies.

(2) Licensing of milk producers and purveyors to use special designations.

(3) Registration of premises for the manufacture and sale of artificial cream.

(4) Registration of margarine and butter factories.

(5) Registration of premises for the manufacture or sale of ice-cream, preserved foods, etc.

(6) Licensing of persons in respect of slaughter-houses and knackers' yards.

In cases 3, 4 and 5 the intention of the Act, as was the intention of previous statutes, is simply that a local authority should know that the premises in question are being used for certain purposes. The Act adds the new provision, however, that if the premises change hands the new occupier shall forthwith give notice of the change to the local authority, if he intends to use the premises for the purpose for which they are registered.

In Paragraph 21 of the Third Interim Report, on which the Act is founded, it is pointed out that difficulties have arisen in the past in connection with the registration of milk purveyors and dairies. Section 2 of the Milk Act, 1922, which governed the position, provided that if the local authority refused registration the applicant might appeal to the Justices and from them to Quarter Sessions. In the meantime he might carry on his business. It was apparently the practice of persons who knew, or had reason to suspect, that they would not receive licenses, to float a Company which applied for a licence. Some considerable time would elapse before the application was finally refused by the Court of Quarter Sessions and the Company, having carried on business during all that time, proceeded to go into liquidation, and a new Company was formed. The provisions of the Act do not appear to exclude altogether the possibility that this practice will be continued in the future but it was, of course, necessary to safeguard the interests of a *bona fide* successor of a legitimate business.

Considerable changes are made in connection with the licensing of persons in respect of slaughter-houses and knackers' yards, but this subject is rather outside the scope of this article.

Food and Drugs Authorities.—The administration of this Act, as of the ones which preceded it, has been entrusted to the Food and Drugs Authorities. This term previously had the meaning assigned to it by Section 13 of the Food and Drugs (Adulteration) Act, 1928, which provided that the following should be the authorities :

1. As regards London, the Common Council of the City and the Metropolitan Borough Councils.
2. The County Borough Councils.

3. Councils of Boroughs having for the time being a separate Police establishment.
4. Councils or Boroughs which had a population of not less than 10,000 according to the 1881 census and had on 13th August, 1888, and for the time being have, a separate Court of Quarter Sessions.
5. Elsewhere, the County Council.

It has been found that this definition gives rise to considerable administrative difficulties and, accordingly, section 64 of the present Act lays it down that the Food and Drugs Authorities for the future shall be:

1. As respects the City of London, the Common Council, and as respects a metropolitan borough, the Metropolitan Council.
2. As respects a county borough, and also any non-county borough or urban district which has, according to the last published census for the time being, a population of 40,000 or upwards, the local authority, and
3. As respects any other area, the County Council.

Regulation-making Powers.—The term "Milk and Dairies Regulations" has been substituted for the term "Milk and Dairies Orders." The power to make such regulations is vested in the Minister of Health, and he is now not compelled, as he formerly was, to act only with the concurrence of, or in some cases after consultation with, the Minister of Agriculture. In the debate on the Livestock Industry Bill, however, it was stated on behalf of the Government that the two departments would confer before any regulations dealing with agricultural matters were framed.

Compensation.—Persons who suffered loss as a result of the wrongful or mistaken exercise by local authorities and other bodies of their powers in regard to food and drugs could, under the pre-existing law, claim compensation in two cases only. These were:

(*a*) Cases where the damage was suffered in relation to a matter as to which the sufferer himself was not in default. He would, however, always be held to be in default unless the Court held that the action of the authority was unjustified. It was found in practice that a successful claim could rarely be made under these provisions, owing to the construction which had been put upon them by the Courts.

(*b*) Cases where a dairyman suffered loss as a result of an order prohibiting the supply of milk likely to cause tuberculosis, unless the order was made as a result of his

own default or neglect. Compensation was also payable where the authority unreasonably neglected or refused to withdraw the order.

The right to compensation is now extended to some extent and may now exist in the following cases :

(*a*) Where food has been seized as unsound by a local authority and a justice has refused to condemn it.

(*b*) Where a medical officer of health has served notice stopping the sale of food on the ground that it is likely to cause food poisoning. If he later withdraws this notice, or if a justice of the peace refuses to condemn it, compensation must be paid to the owner of the food.

(*c*) Where the sale of ice-cream is stopped in similar circumstances, compensation is payable if the medical officer withdraws his notice. It is, of course, impracticable for the matter to be brought before a justice of the peace.

(*d*) Where a private slaughter-house is acquired by the local authority.

(*e*) Where regulations made under the Act provide for the payment of compensation.

Provisions relating to milk and its products.—1. The provisions against the reconstitution of milk have been widened, but there seems reason to doubt whether they will be entirely satisfactory. Section 24 of the Act provides as follows :—

(1) No person shall—

> (*a*) add any water or colouring matter, or any dried or condensed milk or liquid reconstituted therefrom, to milk intended for sale for human consumption; or
>
> (*b*) add any separated milk, or mixture of cream and separated milk, to unseparated milk intended for such sale; or
>
> (*c*) sell, or offer or expose for sale, or have in his possession for the purpose of sale, for human consumption any milk to which any addition has been made in contravention of the provisions of this subsection.

(2) No person shall sell, or offer or expose for sale, under the designation of milk, any liquid in the making of which any separated milk or any dried or condensed milk has been used.

(3) A person who contravenes any of the provisions of this section shall be guilty of an offence.

The immediate object of the section is achieved, for it is believed that no reconstitution process exists at present which does not make use of separated or dried milk. It cannot be said,

however, that such a process may not become commercially possible in the near future, and so render the section a dead letter. It seems unfortunate that this should be the case, especially in view of the fact that it would have been so easy to frame the section in such a way as to exclude the possibility I have indicated.

2. The provisions of the Milk Act, 1915, under which the sale of milk alleged to be tuberculous could be stopped, have been repealed without re-enactment. It is understood that no use has in practice has been made of these powers, since local authorities have taken the alternative course of exercising the power conferred on them by the Tuberculosis Order of 1925 to isolate or slaughter infected cows.

3. The special provisions as to the sampling of milk are contained in the Third Schedule of the Act, and are similar to those which obtained formerly. They are complicated and cannot be regarded as altogether satisfactory.

The first six paragraphs are concerned with "purveyors" of milk, while the seventh deals with dairymen. But a "purveyor" is defined as meaning a person who sells milk, whether wholesale or by retail, and it must therefore include dairymen. Paragraph seven accordingly seems redundant, and its construction in relation to the remainder of the Schedule is a matter of difficulty.

Further, proviso (*b*) to paragraph 2 lays it down that a purveyor shall have no "appeal to the cow" if the milk from which a sample was taken was a mixture of milk obtained by him from more than one person. This provision is clearly aimed at distributors who buy milk from a large number of producers and bulk it. Even in these cases its justice may be doubted, but presumably it is felt that the taking and testing of many samples is impracticable. But the provision also applies to producer-retailers, and accordingly they are debarred from this appeal, which may be of vital importance, if they have bought insignificant quantities of accommodation milk from neighbours. It is naturally impossible to say whether many producer-retailers have suffered in this way, but it seems unfortunate that the opportunity to put matters right was not taken. It is to be hoped that when a future Bill is being drafted the whole of the sampling provisions will be considered and re-modelled in a form which is simpler and less likely to give rise to difficulties of the type indicated.

The Holidays with Pay Act, 1938, provides that a "wage-regulating authority" may direct that workers for whom a minimum rate of wages has been fixed shall be entitled to holidays of a duration to be specified. The authority, so far as agricultural workers are concerned, is the Agricultural Wages

Committee for the district. Any direction given must relate the length of the holiday to the length of the worker's service with the employer and, in the case of agricultural workers, not more than one week of seven days may be allowed in any period of twelve months. Further, the authority may not direct that more than three consecutive days shall be taken at a time.

The holidays so granted are to be exclusive of any holidays or half-holidays to which the worker is entitled under any other Act.

Where an authority makes a direction under the Act, it must also provide that wages, at a rate not less than a fixed minimum, shall be paid in respect of the holiday period.

The Act contains provisions whereby schemes for carrying out its terms may be put forward jointly by organizations representing workers and employers.

The purpose of the BACON INDUSTRY ACT, 1938, is to place the whole industry upon an economic and permanently stable basis. It is hoped to do this by (*a*) re-introducing the contract system, (*b*) "rationalizing" the factories, and (*c*) promoting research and education.

Certain subsidies, dealt with below, will be payable only for the next three years, but with the exception of this temporary provision, the machinery set up by the Act is permanent, and can be amended or abolished only by further legislation.

Before the provisions of the Act are considered in detail, there are certain points which should be noted.

1. There will be, as before, three Boards, namely, the Bacon Development Board, the Pigs Marketing Board, and the Bacon Marketing Board, but many of their most important powers will be dependent upon the new Act. The Bacon Development Scheme, 1935, is revoked and the new Bacon Development Board is dependent entirely upon the Act for its existence and all its powers. Part 6 of both the Pigs and Bacon Marketing Schemes are substantially altered. The rest of the Schemes remain, but Part 6 is in each case the most important part of the present Schemes, including, in the case of the Pigs Marketing Scheme, the Board's power to prescribe contracts.

2. Except where the contrary is expressed, all the powers of the Pigs and Bacon Marketing Boards under the Act must be exercised in accordance with any directions given by the Bacon Development Board.

The Marketing Boards do, however, retain certain very important independent powers. For example, the Pigs Marketing Board has the independent power to determine the contract at any time prior to fourteen weeks before its commencement.

3. If no Factory Rationalization Scheme is in force by the end of two years from the passing of the Act, the effect will be that—

(*a*) All the provisions in regard to bacon quotas will lapse.

(*b*) It will not be possible to refuse a licence for a factory except on the ground that the premises are not suitable for the hygienic production of bacon, and all the conditions in existing licences will become void, with the exception of those intended to secure that the bacon is produced in a hygienic manner.

(*c*) Certain of the provisions in regard to the allocation of pigs to curers will lapse.

4. Producer-curers are now placed in precisely the same position as any other pig producer as regards dealing in pigs for bacon, and are put in the same position as any other curer as regards obtaining pigs and producing bacon (including the payment of levies).

5. The Act enables the Minister to amend the remaining provisions of the Pigs and Bacon Marketing Schemes as may be necessary or expedient in order to bring them into accord with the provisions of the Act. The ordinary power of amendment under the Agricultural Marketing Acts, 1931 to 1933, remains except as regards Part 6 of the Schemes, and it is understood that it is the intention of the Pigs Marketing Board to promote amendments relating to Regional Committees and other important matters as soon as practicable after the Minister has made his amendments consequential on the Act.

These preliminary matters having been disposed of, it is possible to consider the provisions of the Act in more detail. Their length and complication unfortunately forbids a full explanation here, but it is hoped that the following outline will give an idea of the position. Reference must be made to the Act itself, and to the Schemes, in any case of difficulty.

The Act is divided into five parts, and it is convenient to consider each separately.

Part I. Organization.—The new Bacon Development Board is established by Section 1 of the Act and consists of five persons appointed by the Minister, four by the Pigs Marketing Board and four by the Bacon Marketing Board.

Section 2 requires the Development Board to exercise its functions as far as possible in consultation with the Pigs and Bacon Boards, and those Boards must exercise their functions under the Act in accordance with any directions given to them by the Development Board, except where the Act says they are

to act independently. Any such directions have to be entered in a Public Register (Section 32 (4)). If either the Pigs Board or the Bacon Board should disobey the directions of the Bacon Development Board, the Minister may by order transfer to the Development Board any functions of the disobedient Board. Such functions cannot be re-transferred for five years. Section 32 provides that an act done by a Marketing Board is valid even though it disobeys the directions of the Development Board, but a producer or curer who suffers damage is entitled to recover compensation from the Marketing Board, the amount to be agreed or decided by arbitration.

Section 3 provides that, if either the Pigs Scheme or the Bacon Scheme is revoked, the administrative powers of the Pigs Board or the Bacon Board, as the case may be, pass to the Development Board. If the Pigs Scheme is revoked, the Development Board, in performing the functions of the Pigs Board, is to consult such body as the Minister may consider representative of registered pig producers. If the Bacon Scheme is revoked such consultation in the case of the powers of the Bacon Board is to be with a Bacon Curers' Advisory Committee. It will be seen, therefore, that the new Development Board is not dependent for its existence upon the continuance of the Schemes, as the old Development Board was.

Section 4 provides that the Development Board may be wound up, if it itself resolves that it is expedient that this should be done. As the representatives on that Board of the Pigs and Bacon Boards are in a majority over the independent members, it follows that, if the industry so agrees, it may put an end to the Development Board, in which case the Pigs and Bacon Schemes will be automatically revoked and the Act will cease to have effect.

Part II.—The Factory Rationalization Scheme will, if promoted, have as its objects the regulation of the extent of the facilities for producing bacon in Great Britain and the increase in efficiency of the bacon industry. The manner in which these objects may be attained will appear below, but it may be said at once that there can be no compulsory acquisition of factories without compensation, and that the rationalization scheme must exclude from its operations "small curers," *i.e.*, curers producing not more than 60 cwt. of bacon in four weeks.

Under Section 6 the Bacon Board is given the first chance to put forward a Scheme within six months of the passing of the Act. If it does not do so by that time, the Development Board may produce a Scheme. The Development Board will forward the Scheme to the Minister with its observations and an opportunity will then be given for objections and a Public Enquiry.

Part III. Licensing of Bacon Factories.—The general principles of licensing contained in the Act are similar to those which were in the Bacon Development Scheme, 1935, but there are considerable differences of method and detail. Licences are to be granted in respect of particular premises upon which bacon is produced. Premises upon which not more than 40 cwt. of bacon is produced in eight weeks are exempt. "Small curers" must have their premises licensed, but the only conditions which may be imposed are (*a*) that not more than 60 cwt. of bacon should be produced in any four consecutive weeks on the premises and (*b*) conditions to secure that the bacon is produced in a hygienic manner.

The main provisions of the Act do not apply to small curers at all, and their position was explained to the House of Commons by Mr. Morrison as follows :—

"Curers who come within the small curers' class are excluded from the whole scheme of regulation. They can buy pigs where they like, their sales of bacon will not be controlled by quotas, and they will not come within any rationalization Scheme. They will not be subject to efficiency measures. They must be licensed with the Development Board, but the only conditions that can be attached to their licences are those requiring a certain standard of hygiene in the manufacture of bacon. Since they will not come within the Long Contract System, subsidy will not be payable in respect either of the pigs they buy or the bacon they produce. They will be required to contribute to the expenses of the Development Board and the Bacon Marketing Board, but on a considerably lower scale than other curers."

It is interesting to note that Section 10 (*b*) provides, as one reason for refusing a licence for a proposed new factory, the unsuitability of the situation of the premises having regard to the premises at which pigs are being produced and to the facilities for the disposal of bacon produced on the premises.

Under Sections 11 and 13 "subject to rationalization" a licence lasts indefinitely, but its conditions may be varied within narrow limits.

Under Sections 11 and 12 the Development Board may impose a penalty not exceeding £500 in lieu of revoking a licence for breach of conditions, and if the licence is revoked an arbitrator may impose a penalty in lieu of revocation. This is a useful provision because in the past the only remedy for breach of condition was revocation of the licence, which meant putting the curer out of business altogether, a step which obviously could be taken only in very exceptional circumstances.

Part IV. System of Pig Supply.—This part of the Act is the most vital of all, as it contains the main provisions relating to the new Contract System and the Subsidy Provisions.

Speaking generally, Part IV is the Marketing Section of the Act, replacing Part VI of the Marketing Schemes.

Section 16 makes it a criminal offence for a producer of pigs, who is not registered, to sell any pigs to any registered curer, subject to certain exemptions, or for a curer who is neither registered nor exempt to sell any bacon. It is one of the functions of the Pigs Board to enforce this section as respects pig producers.

Section 17 takes the place of Paragraph 42 of the Pigs Scheme and Paragraph 37 of the Bacon Scheme, the latter of which has always been an incomplete check on the curer. Under Section 17, subject to certain exemptions, all pigs going into bacon must be sold and bought *under a long Contract.* No registered curer may buy any carcass or part of a carcass unless the pig has been bought under a long Contract, nor may he produce or sell any bacon unless it is produced from a pig bought under long Contract. Any registered producer or registered curer who breaks this section is liable to a penalty.

Section 18 enables the Development Board to grant exemptions from the Contract System and to prescribe alternative methods of sale, but any such general exemption requires the consent of the Minister. It is under this section that the Development Board made its determination regulating the terms of sale of bacon pigs during October and November 1938 pending the commencement of the new Contract.

Section 19 contains general exemptions from the Contract System, and in the case of pig producers, from the need for registration. The exemptions in the case of the pig producer are for the sale to a registered curer—

(*a*) of pigs not more than 16 weeks old, or

(*b*) of any pigs if the seller has reasonable cause to believe that bacon will not be produced therefrom, or will only be produced therefrom on premises in respect of which no licence is required (*i.e.*, premises of curers not producing more than 40 cwt. of bacon in eight weeks) or on a small curer's premises (*i.e.*, premises of a curer licensed to produce not more than 60 cwt. in four weeks).

It follows from these provisions that pigs may be sold to a curer solely for pork or for manufacturing purposes without restriction, but it will be for the pig producer to show that he had reasonable cause to believe that bacon would not be produced from such pigs in the case of any pigs sold to a curer holding a licence other than a small curer's licence. There are corresponding exemptions in favour of the curer so that he may buy without restriction pigs which the producer is entitled to sell him without restriction.

The producer-curer is only entitled to make bacon from his own pigs if he has first offered them to the Board and the Board has allocated them back to him.

There is also provision enabling curers to make bacon from imported pigs and imported carcasses, if the pigs were imported into the United Kingdom under import regulations.

Section 19 also has a reference to the new system of marking pigs, which is one of the important new methods of enforcing the Contract System, and it seems convenient to mention the matter of marking here before describing the Contract System itself in more detail. Under Section 34 of the Act it is a criminal offence to produce bacon on any premises which require a licence, other than a small curer's licence, unless a grader, employed by the Pigs Board, has marked the carcass in the manner prescribed by the Development Board. Before the mark is affixed the curer has to hand the grader a written statement of the name and address of the seller of the pig and other particulars identifying the sale. It is then the duty of the grader to mark the pigs. It has been suggested that once the carcass has been so marked the curer automatically becomes entitled to make it into bacon. This is not so however. The grader will forward the written statement to the Pigs Board and if the Board finds that the pig was not sold in accordance with the provisions of the Act, then both the producer and the curer will be liable to penalties. Section 34 is strongly re-enforced by the proviso in Section 19 that if the pig has been marked, then it shall be conclusively presumed that bacon has been produced therefrom at a licensed curer's premises, other than a small curer's premises. By this elaborate system of marking it is hoped that evasion of the new Contract System will be made difficult.

The next few sections deal with long Contracts and are highly complicated. It is proposed to deal with the matter here as simply as possible from the point of view of the individual pig producer.

In future, long Contracts will run from 1st December to 30th November. At any time up to 24th August in any year the Pigs Board may determine the forms of Contract in its own right. Between that date and 21st September the Pigs Board is still the only body which may determine the Contract, but it has to get the consent of the Bacon Board. If no Contract has been determined by 21st September, then the Development Board has the right and duty to do so. The Contract must, of course, in any case be settled after consultation between the Boards and the consent of the Development Board is required to any provision in the Contract relating to transport or insurance.

There may be more than one main form of Contract and for each main form there must be five types or variants. It is

understood that it is at present intended to have only one main form of Contract and it will be simpler to explain the matter on that basis. When the Contract with its five different types has been determined, the Pigs Marketing Board must give notice accordingly to producers and curers, and invite producers to make offers of the numbers and classes of pigs which they are prepared to sell during the Contract period. The producer will not (as in the past) fill up his Contract himself. He will make an offer on the appropriate forms to be supplied by the Board, giving certain details and stating particularly whether he wishes to name a curer to whom he desires his pigs to be sold. The Group Contractor will also sign a form of offer but will not be allowed to name his curer. The producer who does not name a curer will receive a premium. The forms of offer must be sent by producers to the Board (without any fee for registration) and the Board will then make a Contract on the back of the form as agent for the producer. The producer's offer operates as an irrevocable authority to the Board to make the Contract for him.

The Board may reduce the number of pigs but cannot require the producer to deliver more pigs than he has offered, nor at any different times. In the case of producers who have duly named a curer and have stated the premises at which they wish the pigs to be graded, the Board must make the Contract with that curer, except in circumstances specified by the Board in their notice informing the producers that the form of Contract has been determined. The Board will get the Contract signed by the curer (and by the Group Agent in the case of a Group Contract). A copy of the Contract will be sent to each of the parties.

As it is the Board which makes the Contract, and not the producer himself, it follows that the producer should not commence deliveries in pursuance of his offer until he has received his copy of the Contract. This is important because if for some reason the Board should not make the Contract for the particular producer (and the Board has a discretion in the matter), then the producer would be liable to penalties if he had commenced delivering pigs.

The significance of this may perhaps be clearer when Section 23 (6) is considered. This is a subsection designed to prevent the making of purely speculative pig contracts. The subsection provides that where the Board reasonably believes that the producer has offered more pigs than he would be in a position to deliver out of the pigs which he has bred, or purchased when not more than 16 weeks old and thereafter kept on premises occupied by him, the Board shall restrict the pigs which he sells under long Contract to the number of pigs which, in the opinion of the Board, he will, apart from circumstances

beyond his control, be in a position to deliver. There is a proviso to this subsection enabling the Board to exempt specified producers from it. Any such exemption would, however, be subject to the directions of the Development Board. There is, of course, nothing to prevent a producer buying pigs in order to fulfil his obligations under a Contract once it is made.

The Development Board may fix the maximum number of pigs which may be allowed on Contract as a whole or of a particular class. In the case of the first three years, this number may not exceed the maximum numbers eligible for Government assistance, *i.e.*, in the first period 2,100,000 pigs, in the second period, 2,400,000, and in the third period 2,500,000 pigs.

As mentioned above, it is for the producer to make his offer and for the Board to make a contract for him. The Contract itself will be in one of the five types or variants specified in Section 22. This section lays down very explicitly what the difference between the five types may be :—

Type A. (Named Curer.) Where the pigs are sold to a curer whom the producer has named as the person to whom he wishes those pigs to be sold.

This is the normal type replacing the old form of direct Contract. It will provide for a premium of 6*d.* per pig (called a change of premises premium) to be payable if the pigs are to be graded at premises other than those specified by the producer in his offer as the premises at which he wished the pigs to be graded.

Type B. (Open Offer.) Where the producer has not so named a curer and does not desire a Group Contract (Type C).

This has to be identical with Type A except that there will be no provision for change of premises premium but there will be :—

(*a*) An allocation premium of a specified sum per pig.

(*b*) A guarantee by the Pigs Board of the performance of all the obligations of the curer subject to specified conditions.

Type C. (Group Contractors.) Where two or more producers are to employ the same Group Agent for the purpose of arranging deliveries under their respective Contracts.

This will be the same as Type B except that it may contain provisions for :—

(*a*) The Group Agent.

(*b*) Sharing of risk between members of the Group.

(*c*) All the Contracts in the Group to count as one for the purpose of computing deliveries.

Group Contracts in the future, subject to these provisions, have to be Contracts between an individual producer and a curer, and not Board Contracts.

Type D. (Transferred Pigs.) Where the producer has named a curer but the pigs are being sold to another curer.

This will be identical with Type B except that the allocation premium must be one shilling, of which sixpence must be payable to the Pigs Board for the benefit of the curer named by the producer as the person to whom he wished the pigs to be sold.

Type E. (Producer-Curers.) Where the circumstances are those specified in certain provisions of the Bacon Industry Act, 1938, relating to curers who produce pigs.

This must be identical with Type B except that the allocation premium is one shilling.

The allocation premiums will be pooled between the curers liable to pay them, so that ultimately each curer pays the same premium in respect of each allocated pig sold to him.

Every long Contract must be a Contract for the sale of pigs by a registered producer to a registered curer. The Pigs Board may also be a party but the Act contains no provisions enabling the Pigs Board itself to buy or sell pigs on long Contract. The Group Agent may be made a party to Group Contracts.

Government assistance is payable only on pigs sold on long Contract. It takes the form of an addition to the price payable by the Curer, who will recover it from the Government.

Sections 26, 27 and 28 deal with the subsidy provisions and their effect is, from the pig producer's point of view, that in the first Contract period he is to receive an average monthly price of 12*s*. 6*d*. per score, free on rail at producer's station, with feeding-stuffs at 8*s*. 6*d*. per cwt. He is given complete cover against any rise in feeding-stuffs and is liable to have deducted an appropriate amount if feeding-stuffs fall below 8*s*. 6*d*.

The standard ration of feeding-stuffs for pigs is :—

Barley Meal	65%
Weatings	25%
Fish Meal (White)	10%

The following Table, which is taken from a note added to the contract by the Pigs Marketing Board, gives examples of how the standard price of 12*s*. 6*d*. per score varies in accordance with

increases or decreases in the ascertained price of the standard ration for pigs.

Cost of Standard Ration (per cwt.) ..	7/6	7/9	8/2	8/6	8/10	9/4	9/6	9/8	10/4	10/6
Standard Price of 12*s*. 6*d*. per score (as varied) ..	11/8	11/10	12/3	12/6	12/9	13/3	13/4	13/6	14/1	14/3

In the second Contract period the price is 12*s*. 5*d*. and in the third Contract period 12*s*. 3*d*.

Part V. Quotas.—Section 29 enables the Bacon Marketing Board, subject to any directions of the Development Board, to determine bacon sales or production quotas in respect of curer's premises.

Part VI. Miscellaneous and General.—There are many important provisions in this Part, most of which have already been referred to.

Section 30 continues the power to regulate imports.

Section 31 relates to producer-curers whose position has already been explained.

It is convenient at this stage to deal briefly with the general safeguards provided under the Act. In the case of a harsh Contract being determined, Section 25 provides that it may be replaced by a Contract less onerous in its terms.

Both the Pigs and Bacon Marketing Schemes contain a general provision entitling a producer to refer any grievance against his Board to arbitration. This general right of arbitration continues so far as it is still applicable. There is no general right of arbitration against a Marketing Board in respect of anything which the Board does under powers conferred by the Act, being powers which are subject to the directions of the Development Board. In that case, however, and in the case of anything done by the Development Board itself, there is a right of appeal to the Committee of Investigation, set up under the Agricultural Marketing Act, 1931. Such an appeal would be an appeal against the way in which the Development Board had exercised, or failed to exercise, its powers. In any case where an appeal to the Committee of Investigation was contemplated it would probably be desirable to communicate first with the Development Board and ask them to exercise their powers. If they failed to do so, then the party aggrieved would be able to appeal to the Committee of Investigation.

This Part of the Act replaces many of the miscellaneous powers of the Boards, which were previously contained in Part VI of the Schemes, giving, for instance, powers of inspection and the right to require information. Any information obtained

is, of course, confidential, and improper disclosure involves liability to criminal proceedings.

Sections 38 and 39 relate to the funds of the Boards. Under Section 38, levies are payable to the Development Board *by pig producers* :—

(*a*) On pigs sold on long Contract.
(*b*) On producer-curers' pigs which they are permitted to retain for bacon purposes.

Levies are payable to the Development Board *by curers* :—

(*a*) On pigs purchased otherwise than under long Contract (but not on pigs bought when not more than 16 weeks old, or pigs not produced in Great Britain, or pigs from which no bacon is produced, or pigs from which bacon is produced on exempt premises, or on a small curer's premises).
(*b*) On every cwt. of bacon produced (not including exempt curers but including small curers).

The Development Board must fix its levy by reference to a Budget of its expenses and liabilities. The expense of a factory rationalization scheme (which will be carried out by the Development Board) is to be charged exclusively on the curing side of the industry but, subject to this, the expenses of the Development Board (including the cost of research) will be spread over the industry as a whole.

Section 39 provides for the funds of the Pigs and Bacon Marketing Boards. The Pigs Marketing Board is entitled to levies not exceeding 1*s*. 6*d*. per pig :—

(*a*) From pig producers on all pigs sold under long Contract and from producer-curers on pigs which they are permitted to retain for bacon purposes.
(*b*) From curers in respect of each pig purchased otherwise than on long Contract (but not on pigs bought when not more than 16 weeks old, or pigs not produced in Great Britain, or pigs from which no bacon is produced, or pigs from which bacon is produced on exempt premises, or on a small curer's premises).

The Bacon Marketing Board levy is payable by curers in respect of every cwt. of bacon produced (except bacon produced by exempt curers).

Section 41 requires the Development Board to submit to the Minister a programme of Research and Education on matters effecting the production and marketing of pigs suitable for bacon or the production and marketing of bacon. The amount to be expended is not to exceed £50,000 a year.

The Pigs Board has prescribed a form of contract, and copies may be obtained free of charge by registered producers and curers on application to the Board at Thames House, Millbank, S.W.1. The terms of the contract cannot be discussed in detail here, but it may be interesting if the circumstances are set out in which the Board may cause pigs, or some of them, to be sold otherwise than to the curer nominated. These are :—

1. That the nominated curer refuses to buy some or all of the pigs, or
2. That the Board decides that the distance over which the pigs would have to be transported would be unnecessarily great, having regard (1) to other sources of supply available and (2) to the situation of the producer's premises in relation to the premises of other curers, or
3. That the acceptance of the producer's offer would mean that the nominated curer would receive more than his due number of pigs. Each curer is only entitled to such number of pigs as bears to the total number contracted for the proportion which his quota bears to the total quotas.

II. DECISIONS OF THE COURTS.

Square v. *Model Farm Dairies (Bournemouth), Ltd.* (54 T.L.R. 821 : 1938 2 A.E.R. 740).

This was a case arising out of the recent epidemic of typhoid at Bournemouth, and it is of considerable importance to milk producers and distributors. The plaintiff had bought milk from the defendants, who were merely distributors, and he alleged that he had suffered damage because, as a result of drinking the milk, several members of his family contracted typhoid fever. It was proved or admitted that there was no negligence on the part of the defendants or any person who supplied milk to them, and that the presence of the typhoid germs was unknown, and could not have been known, to the defendants or to those persons.

The plaintiff relied on Section 2 of the Food and Drugs (Adulteration) Act, 1928, which has now been repealed and re-enacted in substantially the same form by Section 3 of the Food and Drugs Act, 1938. This provided that : "No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, or not of the substance, or not of the quality, of the article demanded by the purchaser. If any person contravenes the provisions of this section, he shall be guilty of an offence." It was argued for the defendant that the section was penal, and that it did not impose upon a seller any civil liability. The Court held, however, that a breach

of the section had been committed, and that the defendants were accordingly liable in damages to the plaintiff.

It is understood that an appeal has been lodged against this decision, and that the hearing will take place in the near future.

Dunstan v. *Benney* (1938. 2 K.B. 1; 54 T.L.R. 167).

The landlord of an agricultural holding served notice to quit upon his tenants, giving as his reason that they were not cultivating in accordance with the rules of good husbandry. The tenants employed a valuer to refute this allegation, which he was successful in doing. They suffered no other loss or expense in quitting the holding, but it was held that that valuer's fees were an expense of a nature which entitled the tenants successfully to claim compensation for disturbance.

Amour v. *Scottish Milk Marketing Board* (1938. Sc. L.T. 347).

In this case it was held that the Board (and, therefore, presumably all other agricultural marketing boards) was entitled to the protection of the Public Authorities Protection Act, 1893. This means that actions against Boards must be commenced within six months of the occurrence which gives rise to the claim. An action which is started after that time will necessarily fail, no matter how well founded in other respects.

Dried Milk Products, Ltd. v. *Milk Marketing Board* (1938, 2 A.E.R. 534; 54 T.L.R. 630).

Rebates are allowed at a certain rate by the Board in respect of milk manufactured into tinned cream, while rebates are allowed at another, and a lower, rate in respect of milk manufactured into other products. The Company put cream into bottles and then sterilized it. They argued that this was, in fact, tinned cream and so earned the higher rate of rebate. Their contention was not accepted by the Court of Appeal.

GORDON G. FAIRBAIRN.

Bedford Row,
London, W.C.1.

AGRICULTURAL STATISTICS, 1938.

THE following table gives, in summary form, the acreages of crops and grass, and the numbers of live stock, returned by occupiers of agricultural holdings on 4th June, 1938, together with the corresponding figures for 1937. The figures for 1938 are subject to revision.

TABLE I.

Acreage under Crops and Grass and Numbers of Live Stock *on Holdings above one Acre in Extent in England and Wales as returned by occupiers on June 4th,* 1938 *and June 4th* 1937.

Distribution.	1938. Acres.	1937. Acres.	Increase (+) or Decrease (−) Acres.
Total Acreage under all Crops and Grass	24,695,000	24,780,000	− 85,000
*Rough Grazings	5,440,000	5,442,000	− 2,000
Arable Land	8,872,000	9,024,000	− 152,000
Permanent Grass for Hay	4,225,000	4,675,000	− 450,000
,, ,, not for Hay	11.598,000	11,081,000	+ 517,000
Total	15,823,000	15,756,000	+ 67,000
Wheat	1,829,000	1,731,000	+ 98,000
Barley	886,000	823,000	+ 63,000
Oats	1,299,000	1,223,000	+ 76,000
Mixed Corn	92,700	92,400	+ 300
Rye	18,700	16,000	+ 2,700
Beans, for stock feeding or seed	129,600	97,000	+ 32,600
Beans, for market or canning	15,200	13,200	+ 2,000
Peas, for stock feeding or seed	38,300	35,000	+ 3,300
Peas, for canning or packeting, green or dried	29,000	25,100	+ 3,900
Green Peas, for market	57,400	45,600	+ 11,800
Potatoes, first earlies	58,500	55,200	+ 3,300
Potatoes, main crop, including second earlies	416,100	400,100	+ 16,000
Turnips and Swedes for stock feeding or seed	405,800	425,800	− 20,000
Turnips and Swedes for human consumption	17,900	14,700	+ 3,200
Mangolds	213,300	207,000	+ 6,300
Sugar Beet	328,500	306,600	+ 21,900
Kohl Rabi	5,400	6,200	− 800
Rape (or Cole)	54,400	55,800	− 1,400
Cabbage, Savoys and Kale for fodder	92,500	84,500	+ 8,000
Cabbage, Savoys, Green Kale and Sprouting Broccoli, for human consumption	43,200	38,200	+ 5,000
Brussels Sprouts	41,300	32,500	+ 8,800
Cauliflower or Broccoli (non-sprouting)	19,900	18,800	+ 1,100
Vetches or Tares	49,100	38,400	+ 10,700
Lucerne	31,200	34,900	− 3,700
Carrots	15,600	13,900	+ 1,700
Onions	2,000	1,700	+ 300
Mustard for seed	23,700	24,100	− 400
Hops	18,500	18,100	+ 400
Small Fruit	50,400	52,100	− 1,700
Orchards	250,700	258,600	− 7,900
Clover and Rotation Grasses for Hay	1,185,000	1,470,000	− 285,000
,, ,, ,, ,, not for Hay	715,000	751,000	− 36,000
Total	1,900,000	2,221,000	− 321,000
Bare Fallow	351,300	534,800	− 183,500

* Mountain, Heath, Moor, Down, and other rough land used for grazing.

The fall in the total agricultural area, at 85,000 acres, was slightly less than in either of the two preceding years. It was, however, not accompanied by any increase in the area returned as rough grazing, and therefore represents the amount of land lost to agriculture altogether. The decline in the acreage of arable land, at 152,000 acres, was higher than that of the previous year. The total is made up of 67,000 acres laid away to permanent grass and the 85,000 acres taken from farms for afforestation, roads, building sites, etc.

With very much more favourable conditions for spring cultivation, the area of bare fallow returned to the normal one of about a third of a million acres.

There was an all-round increase in the acreages of cereal crops, amounting in total to 240,000 acres. This increase more than made good the decline of the previous year. The acreage of wheat has now risen to a figure somewhat above the average for the years 1909–13, a position that may be regarded as fairly satisfactory. On the other hand, the present areas of barley and oats are, in each case, nearly forty per cent. less than those of the pre-War years.

The higher level of prices for feeding stuffs may account for the revival in bean growing. The acreage rose by nearly a third, but is still little more than half that grown in the years before the War.

The potato area has fluctuated within narrow limits in recent years. The increases as between 1937 and 1938 (4 per cent. for main crops and six per cent. for earlies) brings the total to a figure nearly as high as that for 1934. Sugar beet increased by 22,000 acres, making good nearly half the loss registered in 1937. The area devoted to turnips and swedes has been progressively declining for many years and the area for 1938 is another low record. These crops now cover only 37 per cent. of the acreage that was given to them in 1909–13. The area of mangolds was remarkably steady, at about a quarter of a million acres, from 1933 to 1936, but there was a sharp decline, of nearly 40,000 acres, in 1937. This year's figures show a slight recovery, but only a small fraction of the previous year's loss is made good.

There were substantial increases in the acreages of all the more important vegetable crops, ranging from 12 per cent. in the case of carrots to 27 per cent. in that of brussels sprouts. There is a continual risk of over-expansion in vegetable production, but economic causes seem to be driving the arable farmer into the business to an ever-increasing extent.

The figures for rotation grass, etc., show no indication that the general body of farmers are being influenced by the advocacy of ley-farming.

Table II summarises the long-term changes in the areas of the four main categories of farm land, viz. (1) cereals, roots, etc., (2) temporary clover and grass, (3) permanent grass, and (4) rough grazing.

TABLE II.

(Millions of Acres.)

	1909–13.	1931.	1935.	1938.
Cereals, Roots, Potatoes and Vegetables ..	8·68	7·00	7·06	6·97
Clover, Sainfoin and Grasses in Rotation ..	2·59	2·58	2·33	1·90
Permanent Grass	15·96	15·70	15·56	15·82
Rough Grazing	3·78	5·32	5·42	5·44
TOTAL	31·01	30·60	30·37	30·13

The acreage of plough crops has declined since the pre-War period by 20 per cent. and that of rotation grass, etc., by 27 per cent. The area of permanent grass has, on balance, changed very little, the gain from the laying away of arable having been just about equalled by the losses due to reversion to rough grazing and to the withdrawal of land for non-agricultural purposes.

Turning to the live-stock figures, the total number of cattle shows only a very minor change. The decline of confidence in the future of beef prices probably accounts for the smaller number of calves reared, but this is balanced by increases in the number of dairy cows and of two-year-olds.

The nation's ewe flock increased by fully a million head, but the number of lambs was actually less. Probably the actual decline in the lamb crop was not so great as the figures would imply, for there is a tendency to sell an increasing proportion of lambs before the date when the returns are made. However this may be, it seems impossible to account for the fall in sheep prices by an increase in the home supplies.

The number of breeding sows fell by five per cent. on the year, and the number of sucking pigs at the date of the returns was less by 15 per cent. There was, however, a rise in the number of stores and fattening pigs, so that the total number of pigs showed a relatively small decline. The number of working horses showed a small increase, but there was a slight decline in horse breeding. The poultry flock was almost maintained.

All classes of agricultural workers showed a decline and there was evidence in many districts of an acute shortage of labour. The total loss of workers in the year exceeded 42,000. This shows a continuance of the tendency of recent years, and the seriousness of the situation is realised only when the long-term trend is considered. In Table III the figures are given at intervals from 1921, the first year for which figures are available.

TABLE III.

Total Numbers of All Classes of Agricultural Workers *(excluding occupiers and wives of occupiers) in England and Wales.*

1921	869,183
1926	794,899
1931	716,607
1936	640,100
1937	631,700
1938	589,500

The loss in the seventeen years is over 32 per cent. and probably implies, if we include the families of the workers, that about a million people have left the land in the period.

OBITUARY.

LORD DARESBURY.

It is perhaps fitting that a working journalist, who laboured alongside Lord Daresbury in his many activities through several decades, should pay his tribute to the memory of the man whom he most admired in the whole sphere of agriculture and live-stock breeding—admired especially for the downright way he had of getting things done for the benefit of those twin industries. There were nine years between us in the matter of age, but we had common interests in farming, in pedigree stock breeding and in the history and traditions of Cheshire.

Lord Daresbury was a great judge of animals who always knew what he was looking for in pedigree live-stock; and what man ever judged so many different breeds or types? Once at a National Pony Show, in London, I met him going into the ring to judge the Shetland Ponies. "Come and help me, Burrows," he said: "I cannot stand the little beggars." But this was the only breed I ever knew him jib at. No man had a better eye for conformation which, in the case of the harness horse, he put before flashy action.

Honorary Director of the Royal Show.

I well recall the thrill that was felt in Cheshire when Lord Daresbury became Honorary Director of the Royal Agricultural Society's Show. The first of the migratory shows which he staged was at Derby in 1906. This was after the very disastrous venture with the permanent site at Park Royal, where three costly years had been spent. Talking about it in later years, Lord Daresbury confessed that, if a fixed site had been desirable, then London would have been the place; but that the absence of local enthusiasm, the inability to give special encouragement to the particular needs of each district, and the general apathy of the London public in agricultural matters, all tended to bring about the Park Royal disaster. In 1905 matters had come to a crisis, and hard facts had to be faced. Park Royal, as well as Harewood House, for many years the home of the Society, had to be sold, and a new Council, elected upon more democratic lines, was entrusted with the Society's affairs. Many members of the old Council were re-elected, and it was by their knowledge and loyal support that the R.A.S.E. was able to regain the position it had temporarily lost. In 1906 the Derby show (which was visited by King Edward VII) proved a great success.

From that time, and up till the interruption caused by the War, the Shows were regularly held on what his lordship himself

called "the itinerary system" and many of them, under his Directorship, added large sums to the Society's funds. Notable among them were Lincoln in 1907; Newcastle-on-Tyne in 1908; Bristol in 1913; Manchester in 1916; Cardiff in 1919; Derby in 1921; and again Newcastle-on-Tyne in 1923 when, just before the agricultural industry began to collapse, a profit of £19,102 was realized.

For a period of twenty-five years, Lord Daresbury served the R.A.S.E. as Honorary Director of the Show and, during that period, the Society's Show profits wiped out the overdraft of £12,000 caused by the failure at Park Royal and, in addition, built up a substantial reserve fund. Perhaps the most disastrous show of those twenty-five years was at Doncaster in 1912, when newspaper men, arriving on the Monday evening, were met by the extraordinary sight of cattle being re-loaded and sent away as fast as they could go. The fact was that the cattle section had had to be abandoned because a herd of Kerry cattle had travelled from Ireland in a boat with other cattle, some of which had developed Foot and Mouth Disease. As the Kerries had already reached the showyard, there was nothing to be done but return all the cattle, sheep and pigs to their homes. Had it not been for the splendid show of horses, and the consideration shown by the exhibitors in refraining from asking for the return of their entry fees, a heavy financial loss would have been inevitable. As it was, a sum of only £1,232 was lost, and Lord Daresbury remained cheerful amid the gloom and depression that prevailed, as indeed he did at other shows where losses were experienced, for instance when the Society visited localities where a big "gate" was impossible.

Twice Lord Daresbury was President of the Royal Agricultural Society—in 1910, when the show visited Liverpool, and again in 1925 when it went, for a third time, to Chester; he was also chairman of the Chester Executive Committee. On his retirement from the Honorary Directorship in 1930, the Society made him a gift of a gold dessert service. The Earl of Harewood made the presentation, and offered to Lord Daresbury special congratulations on the fact that the last three Shows of his term of office had all shown profits. This was a fine finale to his work, in which he had had the enthusiastic and unfailing support of Lady Daresbury.

After Lord Daresbury gave up his job, the press room at the Royal Show was not the same place. We missed the man who came along periodically on the opening day to ask us "if the results were coming down fast enough for us."

Lord Daresbury gave valuable and practical help to many Cheshire and Lancashire agricultural organizations. In 1908

he was elected President of the Federation of Lancashire and Cheshire Agricultural Societies. He was a Past-President of the Cheshire Agricultural Society and of the Royal Lancashire Agricultural Society, and for many years presided over the affairs of the Warrington and District Agricultural Society, which held its show in Walton Park. He also filled the office of President of the Altrincham Agricultural Society in 1906 and 1923. He was a Past-President of the British Dairy Farmers' Association, and vice-president of the old Agricultural Organization Society, the Central Chamber of Agriculture and the Farmers' Club. His lordship's years of arduous work for breed societies may be summarized by the statement that he was a Past-President of the National Pony Society, the Hunters' Improvement Society, the Shorthorn Society, the Dairy Shorthorn Association, Smithfield Club, the Kerry and Dexter Cattle Society and the National Pig Breeders' Association. He was at one time chairman of the committee which organized the London Van Horse Parade, and often acted as judge. He once also acted as referee for all sections at the Royal Dublin Horse Show. As President of the British Herdsmen's Club from its formation, Lord Daresbury showed his great interest in, and appreciation of, the work of the stockmen. No man was more sought after as a judge of horses, and he officiated in all the rings of the London spring cycle of light horse exhibitions. For a long period Lord Daresbury and the late Lord Woolavington were the largest shareholders in Olympia, London, which was acquired by Mr. Philip E. Hill from them in February, 1929. His lordship was one of the originators of the International Horse Show at Olympia, promoted by a company of which he was vice-chairman for many years.

Building up Two Great Studs.

Before he set out on his venture to "save" the Royal Show, Lord Daresbury had long been associated with Hunter, Hackney, and Hackney Pony breeding. His Hackney stud was at Terrington in Norfolk, and his pony stud at Tissington in Derbyshire. Those names he used as prefixes in the nomenclature of a group of show-winning and breeding stock, the blood lines of which remain virile and flourishing to-day. One of the most notable things about the Tissington stud was the discrimination used in the selection of sires. To have bred three out of the four best ponies that entered the show-rings of Britain over a period of fifteen years was an outstanding achievement. Of all the Tissington families the best was that from which sprang the mare Lady Ethel by Lord Derby II. Among her offspring were Golden Rule (the sire of Flourish) and Ailsa (the dam of Tissington Amity and Amy). Both Golden Rule and Ailsa were by

Goldfinder VI. Lord Daresbury paid the late Mr. Alexander Morton, of Darvel, 3,000 guineas for this one-eyed chestnut stallion who produced many outstanding mares. With the advent of Lord Daresbury's pony stallion Sir Horace, foaled in 1891 and a son of Dorothy Derby, by Lord Derby II, the type of Hackney Pony became fixed, for there had never before existed a more impressive sire of this type. In addition to stamping a strong family resemblance on all his stock, Sir Horace had the faculty of imparting to his progeny the sensational action which he inherited from his parents, his sire having been Little Wonder II, bred in 1883 by the late C. W. Wilson. Sir Horace's first victory at the London Hackney Show was in 1896 and the success was repeated upon seven subsequent occasions; moreover he sired more winners than any stallion of the breed. Another pony stallion, known as Sir Gibbie, re-imported from America, rewarded Lord Daresbury by siring Tissington Gideon, which also impressed his character upon all his progeny. When Lord Daresbury sold five show horses at Aldridge's on May 20th, 1896, Lady Lofty went to Mr. Godsell for 920 guineas, and Amazement, a gelding, realized 700 guineas. The five made 2,450 guineas, or an average of 490 guineas. Among famous show-winning hunters that his lordship possessed were the Creeper, Scarlet, Devonia and Whiteface.

Master of the Belvoir Hounds.

The Dukes of Rutland were at the head of affairs of the Belvoir Hunt until, in 1896, the seventh Duke retired and Lord Daresbury, then less than thirty years of age, took his place. He remained in charge until 1912. The new Master had no previous experience in the command of a pack of foxhounds, but had been an ardent follower of Cheshire Hounds from his boyhood days, gaining his knowledge under Captain Park-Yates and the huntsman, John Jones. His lordship had also gained an insight into the financial aspects of foxhunting by managing the Cheshire covert fund for several seasons. From the moment of his acceptance of the Belvoir Mastership he showed that he was well endowed with the qualifications necessary for such a post. His period of Mastership will always be remembered for its splendid organization, the high average of sport, and the breeding of many notable stud hounds. During the last three seasons of the Belvoir Mastership Lady Daresbury took command, and a most enjoyable period of sport resulted.

Thoroughbred Breeding at Kilmallock.

"Saddle and Sirloin" were closely allied in Lord Daresbury's stud farm at Mount Coote, Kilmallock, in Ireland. There he bred Thoroughbreds for many years. The Shorthorns were of

the Dairy type. Mount Coote, having been uninhabited for many years when Lord Daresbury acquired it, was in a neglected state. He had the lake cleared, the pleasure ground improved, electricity installed, and a high state of efficiency introduced, his improvements giving employment to the folk of the country-side. The place was on the finest hunting grounds of ancient Ireland. Lord Daresbury's practice at Mount Coote was to sell the produce of his Thoroughbred mares as yearlings. In 1919 he had a remarkably fine sale at Doncaster, disposing of six yearlings for 21,250 guineas. The first of these, Gauntley, a chestnut colt by Swynford out of St. Begoe, went to Mr. Joseph Watson for 6,300 guineas; Mr. Bower Ismay gave 5,100 guineas for Balvarran, a bay colt by Prince Palatine out of Carita; Mr. S. M. Dennis paid 1,150 guineas for Euphrosynus, a brown son of Tracery from Eufrosina; that grand bay filly by Santoi out of Fortuna, which he afterwards called Nippon, cost Mr. James Hornung 5,900 guineas to secure; Gerunda, a chestnut daughter of Stedfast from Gera, was bought by Sir Robert Jardine for 1,250 guineas; and Mr. Joseph Watson (later Lord Manton) gave 1,550 guineas for the pretty little chestnut filly by Bachelor's Double out of Cornfield, which he afterwards named Love in Idleness, and with which he won the Oaks in 1921.

In 1920 only four Mount Coote yearlings were offered at Doncaster, but the sale was even more remarkable than that of the previous year. Mr. A. Barclay Walker paid 5,100 guineas for Craigangower, a chestnut colt by Polymelus out of Fortuna; Double Dahlia, a brown son of Bachelor's Double from Adalia, was secured by Mr. Clarence Hatry for a similar sum; Mr. Joseph Shepherd was tempted to pay no less than 9,400 guineas for a bay colt of promise by Tracery out of Port Sunlight, which he named Archery; and a brown filly by Bachelor's Double out of St. Begoe was bought by Mr. Charles Garland for 3,000 guineas. The four thus averaged 5,650 guineas. In 1925 Lord Daresbury disposed of his mares and foals at Newmarket December sales, Eos being secured by Mr. George Ham for France at 2,700 guineas; Sir Percy Newson paid 2,500 guineas for her bay filly-foal by Gainsborough, which he called Ars Divine; the British Bloodstock Agency bought Roseway, covered by Phalaris, for 5,300 guineas, and her bay colt-foal by Buchan for 950 guineas; Mr. Robert Watson purchased Verbena, covered by Buchan, for 2,800 guineas.

Dairy Shorthorn breeding has been continued at Kilmallock, with all the best Bates families. The herd, known as the Loobagh herd, was a hundred strong at the time of his lordship's death. Obstacles to the showing of Irish stock in England made it almost impossible for the Loobagh cattle to be seen on

this side of the Irish sea, but many prizes and not a few championships at Royal and other leading shows have been won by stock of Loobagh descent.

About 45 years ago, Lord Daresbury started breeding pedigree pigs at Higher Walton, his Warrington home. At that period he kept several breeds, including Berkshire and Large, Middle and Small Whites but, after a time, all but the Large Whites were eliminated. As long ago as 1894, there were entries from the Walton herd at the Bath and West Show, held at Guildford. The herd has ever since figured at all the most important shows. Shortly before the War, the Large-White herd belonging to the late Earl of Ellesmere came into the market; Lord Daresbury bought the lot, and added the herd-name Worsley to his own already famous prefix Walton. The Worsley herd had been in existence for half a century and had established a reputation all over the world. The piggeries at Walton still house some 250 head, and a large export trade is carried on. At the Smithfield Show in 1934, three of the four championships were won by Worsley exhibits. No organization owes more to Lord Daresbury than the National Pig Breeders' Association, of which he was President in 1899, 1907, 1915 and 1922. For the last six years of his life he was President of the Crewe and District Pedigree Pig Breeders' Association. Jersey cattle were once bred at Walton, but, after establishing a great showyard reputation, were dispersed, Lady Daresbury taking up the breeding of Kerries.

War-Time Work for the Nation.

The value of Lord Daresbury's knowledge of horses was proved during the War, when he was appointed a member of the Committee on the Supply of Horses for Military Purposes. He was also chairman of the committee which dealt with the demobilization of Army horses. As honorary adviser to the Surplus Government Property Disposals Board, and as a member of the Horses and Livestock Advisory Committee, he did most valuable work. Again, it should not be forgotten that he was chairman of the Live Stock Committee of the Relief of Allies Fund, which was inaugurated by the Royal Agricultural Society, and which reached the sum of £200,000. Stock shipments were made for the relief of farmers in the devastated areas of France, Belgium and Serbia, and reached a total value of £150,000. In this connection Lord Daresbury was awarded the distinction of the Order of the Crown of Belgium. Along with the late James and Charles Macdonald and James Goodwin, the present writer had the pleasure of working with him both in raising the money and distributing the English stock in Belgium.

Lord Daresbury was the proprietor of estates, principally in Cheshire, totalling about 7,000 acres. He took a keen personal interest in his tenants, knew them all by name and, whenever time permitted, was to be found walking or riding about the estate, looking at all that was going on and giving advice and encouragement to those who showed a desire to improve their stock or land. It was a matter of difficulty for a newcomer to get a foothold on the Walton Estate; the farms go down from father to son.

During the War Lord Daresbury provided two auxiliary hospitals and, in conjunction with his brewing firm, of Greenall, Whitley and Co., gave an ambulance as well as two funds of £10,000 each for assisting discharged and demobilized local soldiers and sailors to set up in business in Warrington and St. Helens.

A reverent and dignified simplicity was the keynote of the burial service in St. John's Church, Walton, and this accorded well with the nature of the man whose memory it honoured. The order of service, distributed to visitors from all over England, bore a cross and the simple inscription :—

GILBERT GREENALL,
1st BARON DARESBURY.

Born March 30th, 1867.
Died October 23rd, 1938.
Buried Walton Churchyard October 27th, 1938.

The limited capacity of his pretty church found a thousand or more mourners waiting in the churchyard and the park, against a background of stately trees in their autumn garb of red and gold; and "Gilbert Greenall" was laid to rest among his own folk.

Of the many charming things that were written about him one may quote that of the fellow Shorthorn breeder who penned this epitaph :—

> "A rich man who could have indulged in every sport and pleasure that life has to offer, but who found joy in furthering the interests of others; a busy man who worked overtime with the same loyal object."

G. T. BURROWS.

THE DUKE OF DEVONSHIRE.

It was one of the chief ideas of the founders of the Royal Agricultural Society that it should bring together the great landowner and the squire, the "clean-boot" and the working farmer, the agricultural merchant, the implement maker and all

others who had at heart the advancement of English agriculture. This principle still governs the organization of the Society, and men of all conditions continue to share in the direction of its affairs.

The ninth Duke of Devonshire was one of England's largest landowners, his estates in Derbyshire, Yorkshire and elsewhere extending to 186,000 acres. Apart from his services to agriculture and to this Society, he was eminent in many public affairs. He entered the House of Commons as member for Derbyshire in 1891, and represented that constituency for seventeen years. He was Financial Secretary to the Treasury from 1903 to 1905, and was a Civil Lord of the Admiralty in the early part of the Great War. In 1916 he went to Canada as Governor-General, and filled that office with distinction for five years. After his return he occupied several eminent positions in public life, including the Chancellorship of Leeds University, which made remarkable progress during his period of office.

In 1892, before his accession to the Dukedom, he became a Life Governor of the Royal Agricultural Society, and in 1898 was elected to represent Lancashire on the Council. He was twice President of the Society, first in 1908 when the Show was at Newcastle-on-Tyne, and again in 1933 when the Show visited Derby.

In 1922 the Society decided to allocate a sum of £2,000 annually for the promotion of agricultural research and appointed a standing committee to advise on the allocation of the money. The Duke was appointed chairman of the new committee and continued to serve in that capacity until 1935. The success of the committee in fostering research has been largely due to the knowledge and judgment of its first chairman, and of Sir Merrik Burrell, who acted as vice-chairman.

The Duke took his duties as a landowner very seriously and showed every consideration to his tenants in periods of agricultural distress. Towards the end of his life one of his most pleasant memories was that of his association with the "Royal." His last appearance at a General Meeting was in 1935 when he deputised for the President, H.R.H. the Duke of Kent. On that occasion he said: "I have not written and I do not propose to write my reminiscences, but I can assure you that if I did so my connection with the Royal Agricultural Society of England would occupy a very high and honoured place."

LORD HARLECH.

In Lord Harlech, who died at the age of 83, the Society has this year lost a third past President, whose connection with the "Royal" has lasted fifty years.

Lord Harlech was a soldier by profession, and rose to the command of the Welsh Guards. He was a large landowner, and devoted most of his leisure to farming and to country sports.

At his home farm near Oswestry he was a successful breeder of Welsh Black Cattle, of Dairy Shorthorns and of Shropshire sheep, and from time to time sent exhibits of all these classes of stock to the Society's Show.

Lord Harlech became a member of the Society in 1888, a Governor in 1892, and was first elected a member of Council, for his home county of Shropshire, in 1910. It was in 1928, when the Show visited Nottingham, that he held the office of President.

Lord Harlech embodied the finest qualities of the English land-owning nobility. The Society mourns his loss and remembers his services with gratitude.

THE CARDIFF SHOW, 1938.

As long ago as May, 1934, the Council accepted an invitation cordially tendered by the Lord Mayor and Corporation of Cardiff for the Royal Show to visit their City this summer, the Marquis of Bute, at the same time, kindly placing land on Pontcanna Farm at the Society's disposal, as he had done in 1919.

The Royal Welsh Agricultural Society, after a conference between representatives of the two Societies, generously agreed to forgo their own annual show in 1938, and their members were afforded the same privileges as members of the Royal Agricultural Society of England in connection with the Cardiff Show.

This year's event was the fourth of its kind to be held in the City. The third visit of the Society would, under normal conditions, have taken place in the year 1917, but it had to be postponed until after the War. When it was held in 1919 the Show met with overwhelming success. It may be remembered, too, that eleven years ago the Society held its show in the neighbouring county of Monmouth, at Newport. Below are some figures of entries, attendances and financial results of the four Cardiff meetings and that at Newport in 1927 :—

Year.	Place.	President.	No. of Implement Stands.	Entries of Live Stock.	No. of Persons Admitted.	+ = Profit − = Loss
						£
1872	Cardiff	Sir W. W. Wynn, Bt.	308	1,293	85,185	− 602
1901	Cardiff	3rd Earl Cawdor	358	1,575	167,423	+ 1,998
1919	Cardiff	Sir J. B. Bowen-Jones, Bt.	371	2,502	191,694	+ 12,039
1927	Newport	1st Viscount Tredegar	369	2,871	62,367	− 10,827
1938	Cardiff	Earl of Plymouth	342	2,958	80,378	− 3,263

The showground, some 97 acres in extent, situated between Cathedral Road and the River Taff, and within easy reach of the centre of the City, was substantially the same as that utilized in 1919. The Main Entrance was approached from Cathedral Road *via* Talbot Street, but the recreation ground, which on the former occasion formed part of the showyard, was used this year for the parking of cars. A second public entrance, on the north-west side of the ground, was approached from Western Avenue and Llandaff Fields. Here also ample space was provided for car parks and the Royal Automobile Club again undertook the duties of arranging the parking and "signing" the routes to the Show.

Prizes offered amounted in all to £15,953. Towards this total, Breed Societies generously contributed £3,564. As the

Show was in the Principality, additional classes were included in the prize-list for all the Welsh breeds of livestock and, on the whole, these were very well supported. The illustrations to the report this year are confined to animals of the Welsh breeds.

Heavy horses, headed for numbers by the Suffolks, were almost up to last year's entries; but the Light Horse classes were not so well filled. Cattle, though not so many as at Wolverhampton, formed a section of much merit, the Dairy Shorthorn breed once more leading with 165 entries. With an aggregate of 662, sheep were nearly a hundred more than last year, Southdowns as usual topping the section. In the pig classes, Large Whites, with 212, made up a third of the entries, the Essex breed coming next with 94.

Parades of prize-winning pigs of the principal breeds, begun as an experiment at Wolverhampton, were repeated in the Cardiff showyard.

The classes for Galloway Cattle, Highland Cattle and Cheviot Sheep were cancelled owing to insufficient entries.

Restrictions consequent on an outbreak of foot-and-mouth disease in Gloucestershire during the month of June unfortunately prevented some of the animals entered being sent to Cardiff, the sections most affected being Hereford cattle and Ryeland sheep.

Exhibitors in the Devon Close Wool sheep classes secured publicity in the Press by reason of their enterprise in sending their animals to the show by aeroplane from Barnstaple. This is believed to have been the first occasion on which this means of transport has been adopted for Royal Show exhibits.

Poultry exhibits, which have shown a progressive reduction in numbers since 1933, were fewer than half the number at Cardiff in 1919. In the Produce section, eggs and cider had more entries than in the previous year, and the total was above the average for the past five years.

Accompanying this report are (1) a table of entries at the 1938 Show compared with those of previous years, and (2) a statement comparing the prizes offered, classification and entries at the last two Cardiff Shows.

As on former occasions, a complete list of the Judges' Awards will be found in the Appendix.

One of the most interesting of the special features at Cardiff this year was the display of Colliery Horses organized by the Monmouthshire and South Wales Coalowners' Association. The horses, forty in number, were in charge of the hauliers who work with them in the pits. The stables of these animals were attractively arranged, and were thronged with visitors throughout the week.

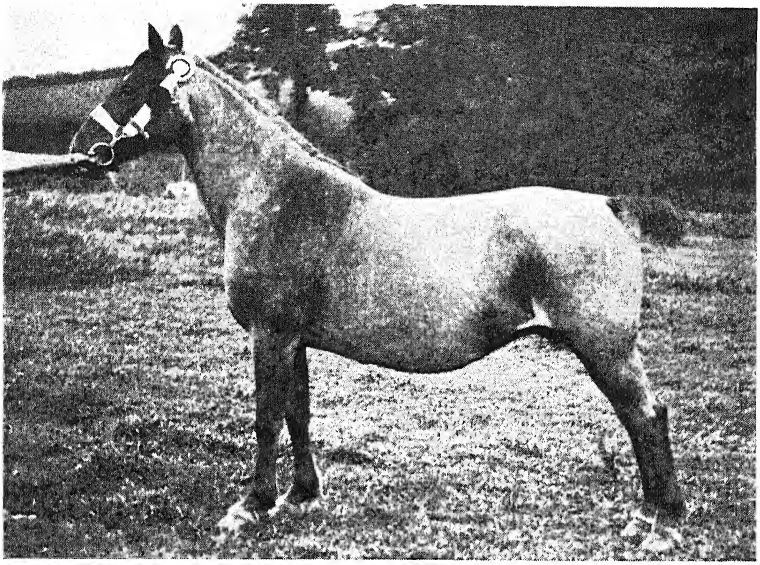

FIG. 1.—WELSH PONY MARE, "MYRTLE ROSINA."
Winner of Champion Silver Medal for best Welsh Pony, Cardiff, 1938.
Exhibited by MR. JOSEPH LEWIS.

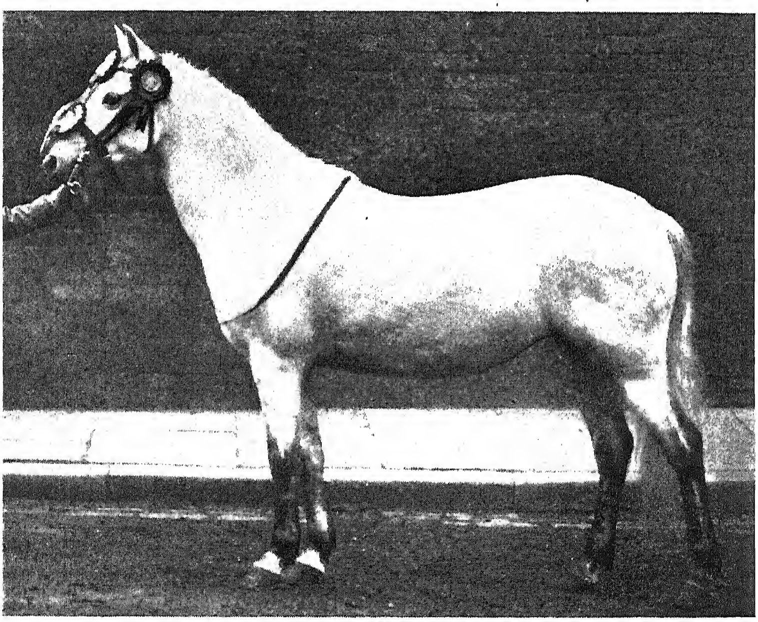

FIG. 2.—WELSH PONY MARE, "TAN-Y-BWLCH PRANCIO."
First Prize Winner in Classes 60 *and* 67, *Cardiff,* 1938.
Exhibited by MISS M. BRODRICK.

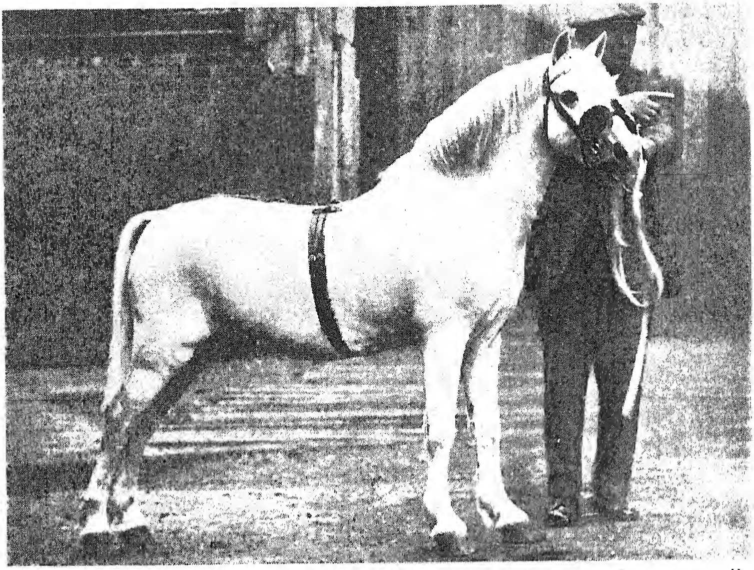

FIG. 3.—WELSH MOUNTAIN PONY STALLION, "GROVE SPRIGHTLY."
Winner of Champion Silver Medal for best Welsh Mountain Pony Stallion or Colt, Cardiff, 1938.
Exhibited by MR. TOM JONES EVANS.

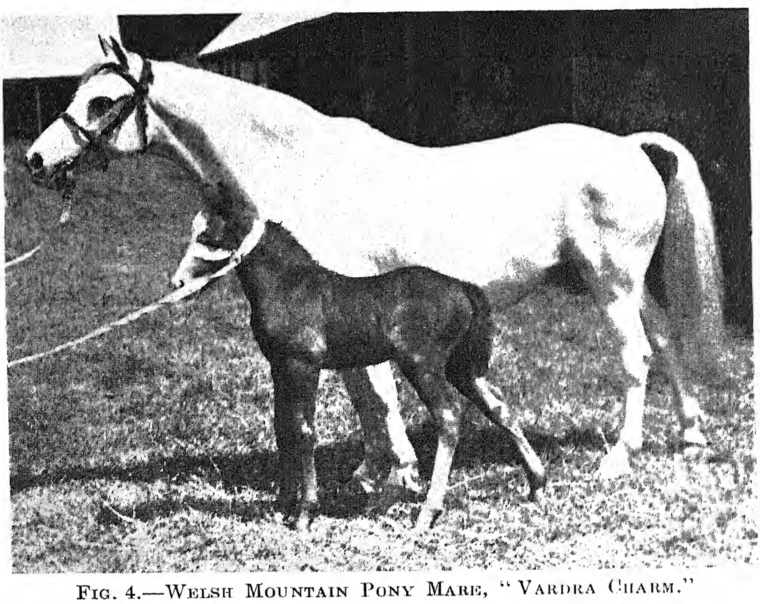

FIG. 4.—WELSH MOUNTAIN PONY MARE, "VARDRA CHARM."
Winner of Champion Silver Medal for best Mare or Filly, Cardiff, 1938.
Exhibited by MR. MATTHEW WILLIAMS.

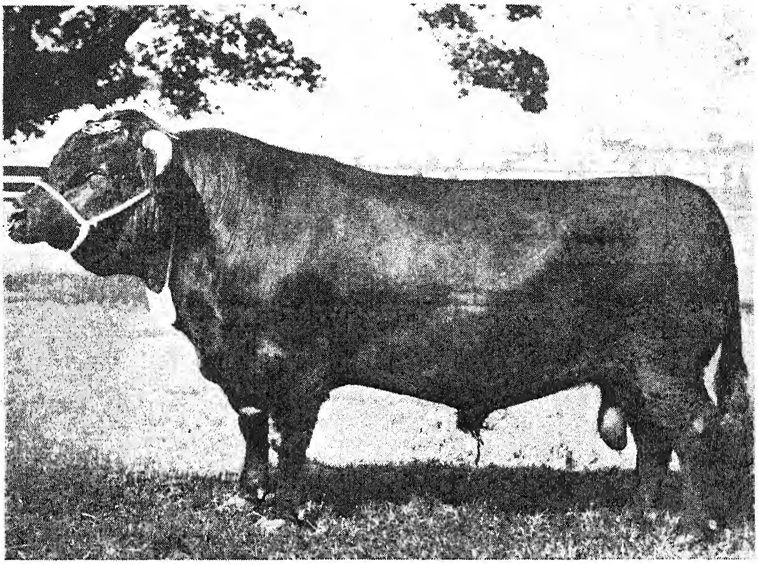

FIG. 5.—WELSH BULL, "PENRHYN BARON."
Winner of Champion Silver Medal for best Welsh Bull, Cardiff, 1938.
Exhibited by LORD PENRHYN.

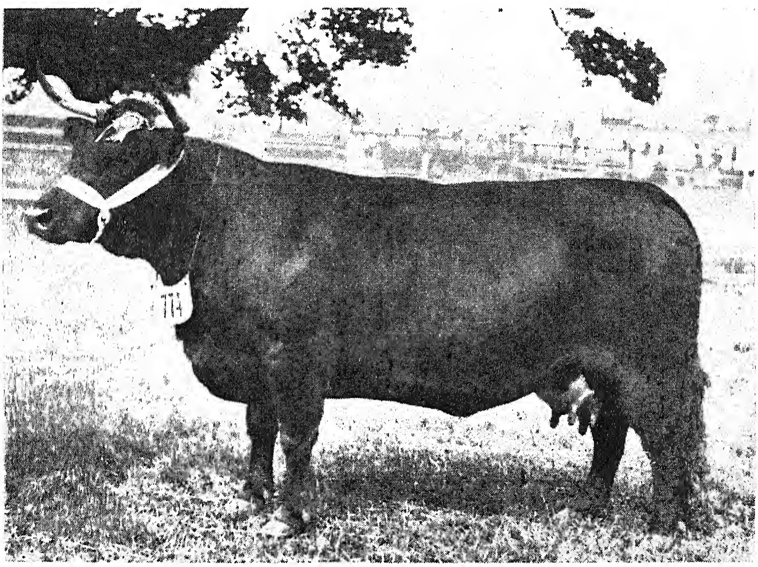

FIG. 6.—WELSH COW, "CALENIG 15TH OF PENRHYN."
Winner of Champion Silver Medal for best Welsh Cow or Heifer, Cardiff, 1938.
Exhibited by LORD PENRHYN.

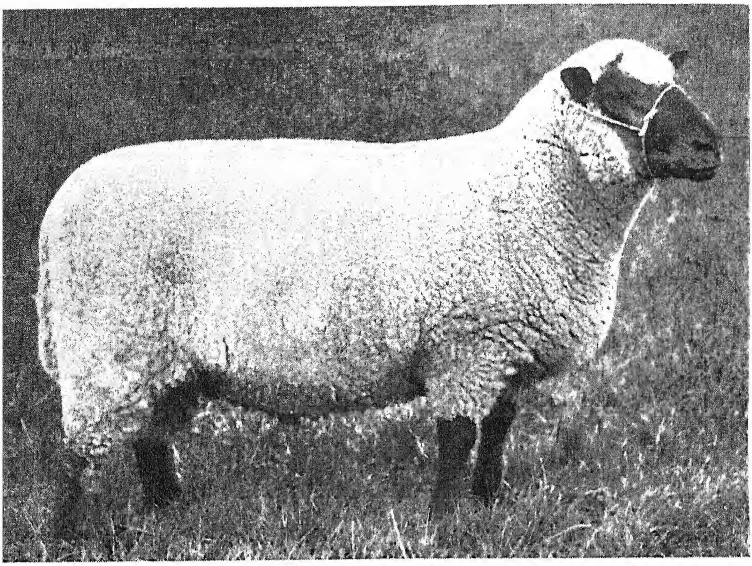

FIG. 7.—CLUN FOREST TWO SHEAR RAM, "BEDSTONE MAJOR."
First Prize Winner, Cardiff, 1938.
Exhibited by MR. T. E. GWILLIM.

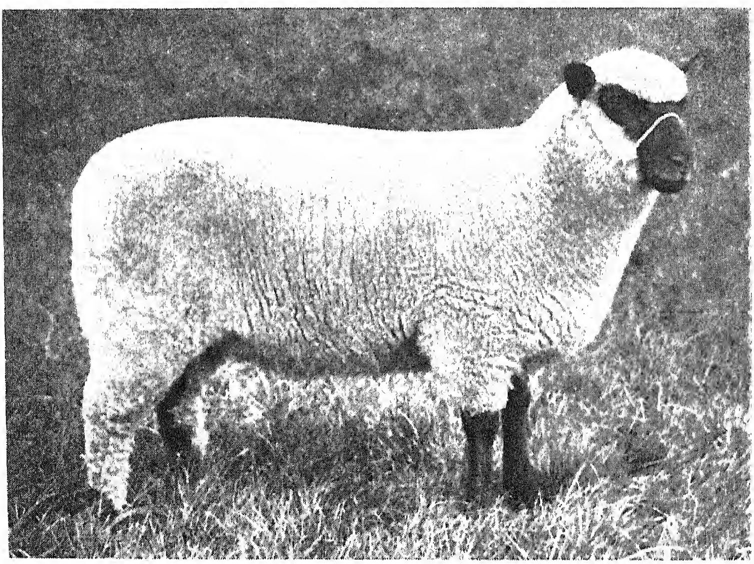

FIG. 8.—CLUN FOREST EWE LAMB.
First Prize Winner, Cardiff, 1938.
Exhibited by MESSRS. DAVIES BROTHERS.

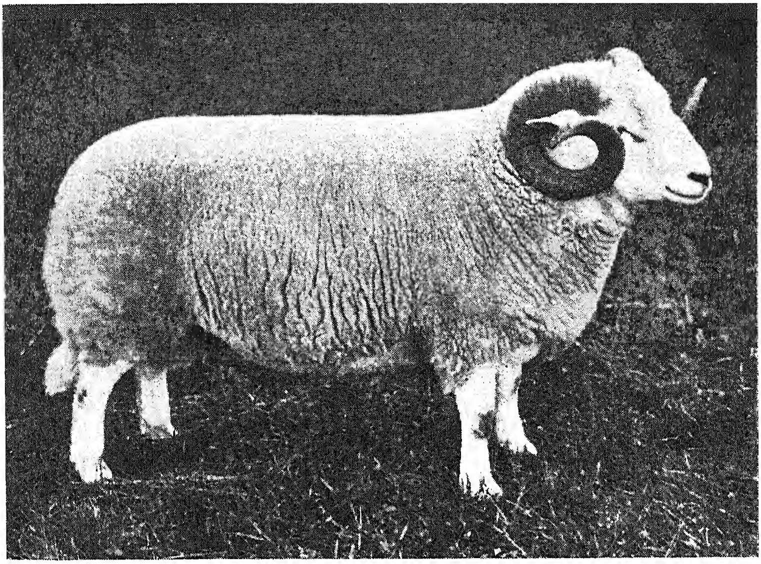

FIG. 9.—WELSH MOUNTAIN TWO SHEAR RAM, "BRYNOWEN K.6."
First Prize Winner, Cardiff, 1938.
Exhibited by MR. W. ROBERTS.

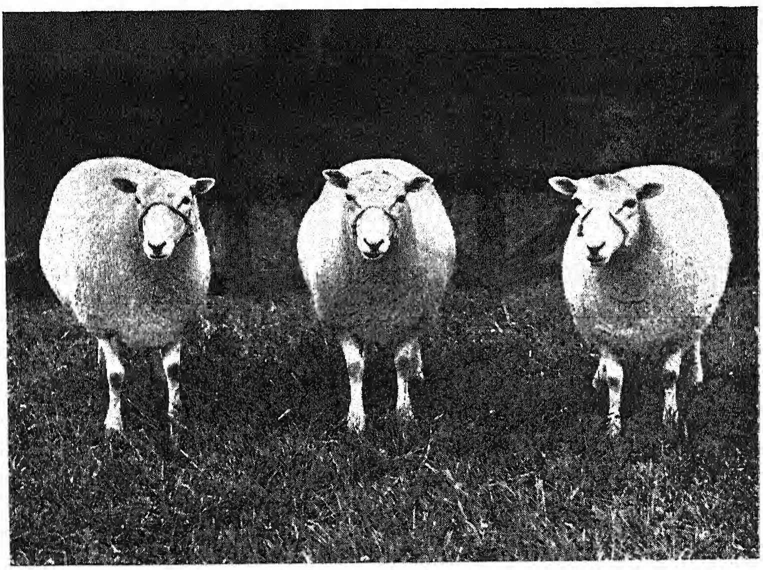

FIG. 10.—WELSH MOUNTAIN SHEARLING EWES.
First Prize Winners, Cardiff, 1938.
Exhibited by MR. WILLIAM PETHERICK.

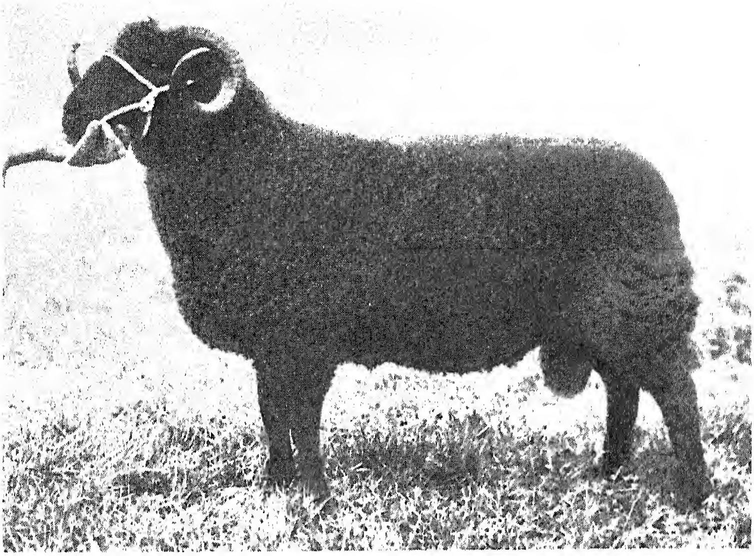

FIG. 11.—BLACK WELSH MOUNTAIN SHEARLING RAM, "LLANOVER NONPAREIL."
First Prize Winner, Cardiff, 1938.
Exhibited by MAJOR J. A. HERBERT, M.P.

FIG. 12.—BLACK WELSH MOUNTAIN SHEARLING EWES.
First Prize Winners, Cardiff, 1938.
Exhibited by MAJOR J. A. HERBERT, M.P.

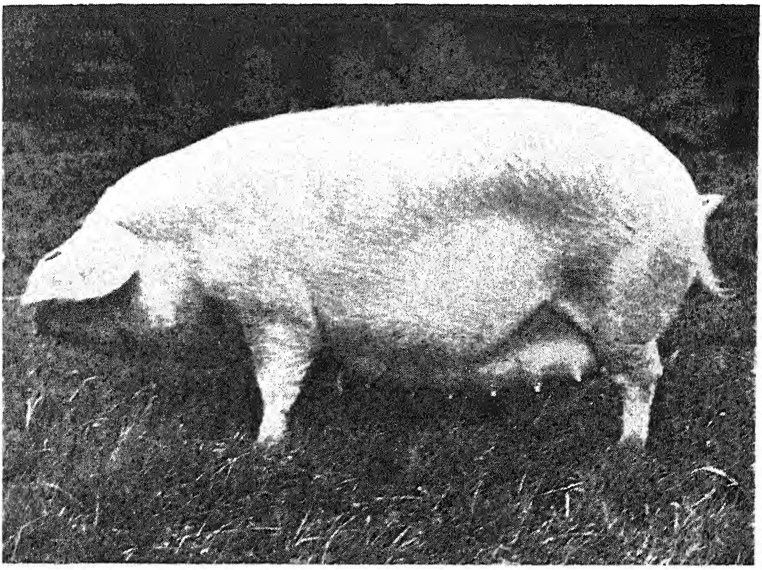

FIG. 13.—WELSH SOW, "PRESTATYN DILYS 1ST."
Winner of Champion Silver Medal for best Welsh Sow, Cardiff, 1938.
Exhibited by MR. R. EWART OWEN.

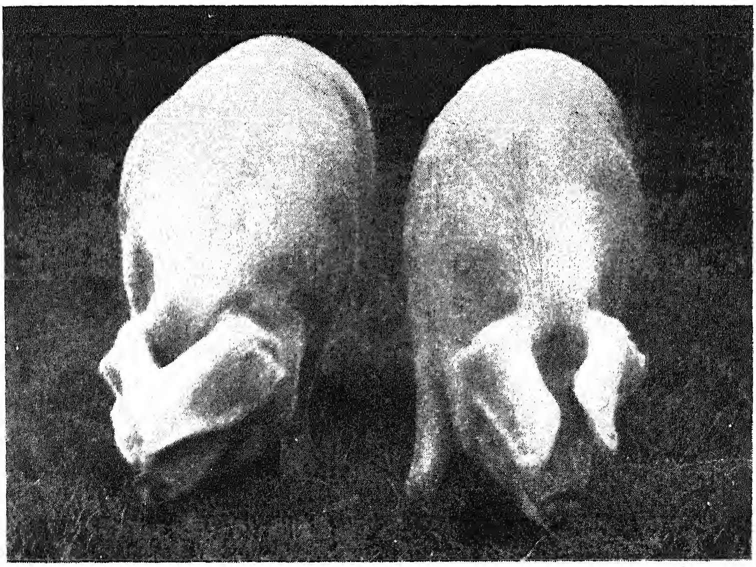

FIG. 14.—PAIR WELSH SOWS, "LYDMOOR MEGAN 4TH," AND "SILURIAN DIANA 1ST."
First Prize Winners, Cardiff, 1938.
Exhibited by MR. DAVID THOMAS.

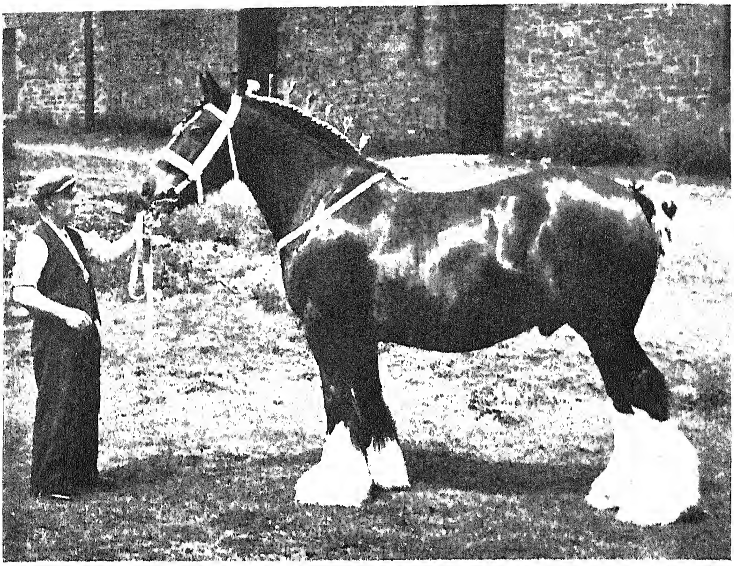

Photo by] [*Farmer & Stockbreeder.*

Fig. 15.—Colliery Horse, "Penallta Emperor."

Winner of First Prize and Silver Cup for best Colliery Horse exhibited by a Colliery Company, Cardiff, 1938.

Exhibited by Powell Duffryn Associated Collieries, Ltd.

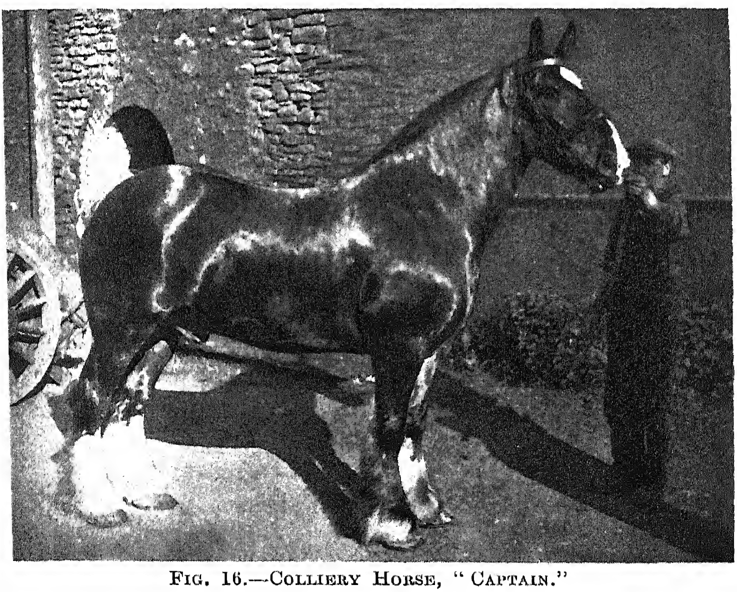

Fig. 16.—Colliery Horse, "Captain."

STATEMENT OF ENTRIES FOR THE 1938 SHOW, COMPARED WITH PREVIOUS YEARS.

Entries of Live Stock, Poultry & Produce.

—	Cardiff, 1938.	Wolverhampton, 1937.	Bristol, 1936.	Newcastle, 1935.	Ipswich, 1934.	Derby, 1933.	Southampton, 1932.	Warwick, 1931.	Cardiff, 1919.
Horses ..	*524	*620	*617	*644	*729	*592	*437	*568	*569
Cattle ..	*1,075	*1,245	*1,252	*1,060	*1,281	*1,149	*1,009	*1,168	*867
Goats ..	*63	*57	*68	*68	*107	*97	*75	*68	*91
Sheep ..	662	566	592	684	576	573	520	569	586
Pigs ..	634	703	669	593	841	688	551	688	389
Total ..	2,958	3,191	3,198	3,049	3,534	3,099	2,592	3,061	2,502
Poultry ..	542	627	651	668	792	984	840	741	1,383
Produce ..	379	339	426	332	269	264	274	253	387

* Exclusive of Double Entries.

Shedding in Implement Yard (in Feet).

Description of Shedding.	Cardiff, 1938.	Wolverhampton, 1937.	Bristol, 1936.	Newcastle, 1935.	Ipswich, 1934.	Derby, 1933.	Southampton, 1932.	Warwick, 1931.	Cardiff, 1919.
	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
Ordinary ..	1,565	1,950	1,765	1,760	2,240	2,095	1,845	2,190	4,540
Machinery	3,930	4,150	3,850	3,880	3,530	2,935	2,630	3,690	4,200
Special .. (Seeds, Fertilizers, etc.)	2,645	2,989	3,163	3,071	3,176	3,360	2,450	3,083	2,469
Total .. (Exclusive of Open Ground Space.)	8,140	9,089	8,778	8,711	8,946	8,390	6,925	8,963	11,209
No. of Stands	342	409	377	356	387	349	311	388	371

There were also four competitive District Classes for Colliery horses, classified according to the periods the animals had spent below ground. The Silver Cup in this section was awarded to *Penallta Emperor*, a dark brown gelding, aged six, standing 15 hands, with two years' pit service, described as "perhaps the most famous colliery horse in South Wales." (*See* Fig. 15.)

Prominent in the Machinery and Implement section was the exhibition, covering some 24,000 sq. ft., organized by the South Wales and Monmouthshire Area Committee of the British Electrical Development Association. It took the form of an almost complete "Electric Farm" with all the most recently introduced devices for the saving of labour. This proved to be one of the principal attractions of the Show, and it is safe to say that few of the visitors missed seeing it.

COMPARATIVE STATEMENT OF ENTRIES, ETC.

At the Shows held at Cardiff in 1919 *and* 1938.

HORSES, CATTLE, AND GOATS.	1919.		1938.	
	Classes	Entries	Classes	Entries
HORSES:—				
Prizes		£3,420		£3,961
Shire	11	72	11	70
Clydesdale	9	22	5	24
Suffolk	8	60	13	100
Percheron	3	40	9	48
Hunter	12	45	10	54
Polo Pony	5	40	5	32
Cleveland Bay ..	2	4	—	—
Coach Horse ..	2	7	—	—
Hackney	7	17	—	—
Hackney Pony ..	4	21	—	—
Arab	—	—	3	15
Welsh Pony ..	13	47	11	40
Shetland Pony ..	2	7	2	8
Riding Classes—				
Hunters	5	92	7	88
Cobs	—	—	1	7
Hacks	4	34	2	17
Children's Ponies	—	—	3	29
Driving Classes ..	7	56	10	54
Local	8	59	—	—
Jumping	4	95	5	162
Trotting	4	16	—	—
Total for HORSES	110	734	97	748[1]
CATTLE:—				
Prizes ..		£2,979		£6,751
Shorthorn	11	117	11	55
Hereford	10	111	9	65
Devon	6	29	5	29
Sussex	5	21	4	15
Welsh	8	30	7	31
Park	—	—	3	11
Longhorn	4	15	4	16
Aberdeen-Angus ..	6	41	6	56
Belted Galloway ..	—	—	4	19
Galloway	5	25	4	—[3]
Highland	—	—	3	—[3]
Dairy Shorthorn ..	7	95	11	165
Lincolnshire Red Shorthorn ..	8	33	7	40
South Devon ..	5	22	4	22
Red Poll	6	45	9	95
Blue Albion ..	—	—	5	22
British Friesian ..	6	79	12	117
Ayrshire	3	8	7	90
Guernsey	7	71	8	63
Jersey	8	105	7	112
Kerry	4	8	3	18
Dexter	4	19	5	28
Dairy Cows ..	2	—	—	—
Milk Yield	13	99	11	82
Butter Test ..	3	82	2	55
Total for CATTLE	131	1,055	151	1,212[1]
GOATS:—				
Prizes ..				£120
Inspection Classes..	11	89	10	63
Milk Yield	2	21	2	64
Total for GOATS..	13	110	12	127[1]

SHEEP, PIGS, POULTRY AND PRODUCE.	1919.		1938.	
	Classes	Entries	Classes	Entries
SHEEP:—				
Prizes ..		£2,021		£2,115
Oxford Down ..	5	49	5	32
Shropshire	7	64	6	33
Southdown.. ..	6	57	7	93
Hampshire Down ..	6	45	5	46
Suffolk	6	24	6	54
Dorset Down ..	3	4	3	25
Dorset Horn ..	4	17	3	26
Wiltshire Horn ..	—	—	3	13
Ryeland	5	43	4	30
Kerry Hill (Wales)	4	36	5	29
Clun Forest ..	—	—	5	30
Lincoln	6	36	4	25
Leicester	4	9	3	9
Border Leicester ..	3	19	4	31
Wensleydale ..	6	25	5	21
Kent or Romney Marsh	6	61	6	35
Cotswold	4	15	—	—
Devon Long Wool..	3	6	2	6
Devon Close Wool..	—	—	2	8
Lonk	3	4	—	—
South Devon ..	5	14	2	6
Dartmoor	3	15	2	8
Derbyshire Gritstone	2	5	—	—
Herdwick	3	6	—	—
Exmoor Horn ..	3	10	—	—
Black-faced Mountain	2	7	—	—
Cheviot	3	9	2	—[3]
Welsh Mountain ..	4	6	6	74
South Welsh ..	2	—	—	—
Black Welsh Mountain	—	—	4	28
Total for SHEEP..	108	586	94	662
PIGS:—				
Prizes ..		£1,057		£1,743
Large White ..	8	75	8	212
Middle White ..	6	40	8	52
Tamworth	6	26	6	30
Berkshire	6	49	8	44
Wessex Saddleback	—	—	6	46
Large Black ..	6	121	8	65
Gloucestershire Old Spots	6	62	6	26
Lincolnshire Curly Coated	6	16	—	—
Cumberland ..	—	—	4	13
Essex	—	—	8	94
Long White Lop-Eared	—	—	5	27
Welsh	—	—	7	25
Total for PIGS ..	44	389	74	634
POULTRY:—				
Prizes ..		£458		£321
Entries ..	148	1,383	96	542
PRODUCE:—				
Prizes ..		£585		£391
Entries ..	112	466	54	379

Grand Totals for LIVE STOCK, POULTRY, PRODUCE, &c., in 1938 } 578 Classes 4,304 Entries £15,953 Prizes.[2]

[1] Animals exhibited in more than one class are here counted as separate entries.
[2] Including £423 for Flower Show, £78 for Butter-Making Competitions, and £50 for Young Farmers' Clubs
[3] Classes cancelled under regulatio of Prize Sheet.

At the 1938 Show, in addition to above, the Cardiff Local Committee provided District and Local Classes for Colliery Horses, Children's Riding Ponies, Harness Horses, Light and Heavy Horse Trade Turn-outs, Butter and Cheese and organized competitions for Timbering, Steel Arching, Rope Splicing and Capping. Particulars of classes and prize-winners will be found in the Appendix to this volume.

The Horticultural Show, despite the unfavourable weather earlier in the year, was well up to its usual standard of excellence, and, as on former occasions, was a most popular section.

In the pavilion of the Ministry of Agriculture and Fisheries, which is always a source of much interest to show-goers, there were exhibits dealing with the production, up to National Mark standards, of eggs, honey, cheese, vegetables and poultry. The candling and grading of eggs was demonstrated, and live cattle were shown to illustrate the different grades under the Grading and Dead-Weight scheme.

In later pages of this *Journal* will be found separate reports dealing with the New Implements gaining the Society's Medals, the Milk Yield and Butter Test Trials, the Education and Research exhibit, the Forestry section, and the Woodlands, Plantations and Estate Nurseries Competition.

After a night of very heavy rain, the Show opened on Tuesday, July 5th, in fair weather and, though there were showers in the afternoon, judging in the breeding classes was completed according to programme.

As an experiment this year the usual General Meeting of Governors and Members was held in the showyard at 4 p.m. on the Tuesday, instead of later in the week. It cannot be claimed however that the change was a success, for the number of Members present in the Tent was very small.

On the Wednesday an official visit was paid to the Show by H.R.H. The Duke of Kent, who travelled from Heston by air. His Royal Highness arrived about noon, in glorious sunshine, and was met at the Entrance by Mr. Roland Burke (Honorary Director of the Show), and conducted through the Implement and Machinery section to the Royal Pavilion, where the President (the Earl of Plymouth) and other members of the Council and Local Committee were waiting to receive him. His Royal Highness first went to the Flower Show tents in which he spent nearly three-quarters of an hour inspecting the exhibits. Returning to the Pavilion, the royal visitor was the guest of the President at luncheon.

During the afternoon the Duke of Kent visited various sections of the Show, including the "Electric Farm," and the stables of the colliery horses. Here His Royal Highness talked with the men about their work, complimenting them on the excellent condition of their charges. As a memento of the occasion, Sir John Beynon, on behalf of the Monmouthshire and South Wales Coalowners' Association, presented His Royal Highness with a chromium-plated model of a miner's lamp.

H.M. the King's exhibits of Devon Cattle were then inspected, and later, from the Royal Box in the Grand Stand, His Royal

Highness watched a number of the events in the Large Ring, including the parade of Lady Curre's Hounds and the Musical Ride of the 5th Royal Inniskilling Dragoon Guards. His Royal Highness left the showground about 4.30 p.m.

Among the visitors during the day were Prince Frederick of Prussia and his sister Princess Cecile, who joined the royal party after luncheon.

In the 17th annual International Dairy Cattle Judging Competition, organized by the National Federation of Young Farmers' Clubs, which was decided in the showyard on the Wednesday, teams representing England, Wales, Scotland and Northern Ireland took part. So keen was the competition that only two marks separated the team from Northern Ireland, who won, from the English team. Wales took third place and Scotland fourth.

Throughout the night of Wednesday rain again fell continuously, and on the Thursday there were many showers. There was a good entry in the Young Farmers' beef and dairy cattle classes which were judged on the Thursday, and the animals shown reflected much credit on their youthful owners. In the afternoon, the Earl of Plymouth, as President of the Royal Agricultural Society, accompanied by Lady Plymouth, received the young farmers in front of the Royal Pavilion, and presented the Cup, medals and certificates awarded in the Judging Competition. The Minister of Agriculture (Mr. W. S. Morrison) and Sir Merrik Burrell also addressed the assembly. Afterwards, the young farmers paraded their cattle in the ring, preceded by the members of the International teams, carrying their banners.

On the Friday there was an improvement in the weather, but the attendance was disappointing, being little more than half that of the day before.

On the Saturday several events of local interest had a place in the programme, and with the price of admission down to one shilling, the Show attracted the biggest crowd of the week. The special attractions included Timbering, Steel Arching, Rope Splicing and Capping Competitions, district classes for Colliery Horses, Trade Turnouts, etc.

Events in the Ring during the week, after the judging day, included parades of Heavy Draught Horse Teams of the Shire and Suffolk breeds and of Colliery Horses from all parts of the Monmouthshire and South Wales coalfield, Horse Jumping Competitions over the course of fences and water, Musical Rides and Trick Riding displays by a detachment of the 5th Royal Inniskilling Dragoon Guards, and parades of the following packs of hounds :—on Wednesday, Lady Curre's ; on Thursday,

the Monmouthshire; on Friday, the Glamorgan; and on Saturday, the Llangibby.

Competitions for Shoeing Smiths were organized and conducted by the National Master Farriers' and Blacksmiths' Association.

The Hives and Honey section was arranged by the British Bee-Keepers' Association on similar lines to those at former shows.

Musical programmes were performed daily in the showyard by the Band of the 5th Royal Inniskilling Dragoon Guards.

Below are given details of this year's turnstile returns, with comparative figures for previous years:—

Admissions by Payment at Cardiff.

Day of Show.	11 a.m.	1 p.m.	3 p.m.	5 p.m.	Day's Total.
Tuesday (5*s.*) ..	1,687	2,921	3,642	4,045	4,128
Wednesday (5*s.*) .. after 2 p.m. (3*s.*)	2,882	6,905*	13,997	18,361	18,980
Thursday (3*s.*) ..	4,128	13,240	18,835	21,774	22,262
Friday (2*s.* 6*d.*) ..	1,895	5,308	9,228	11,363	11,882
Saturday (1*s.*) ..	2,981	7,249	15,356	22,282	23,126
Total for Show					80,378

* 2 p.m.

Total Daily Admissions at 1938 *Show compared with those of the previous six Shows and that at Cardiff in* 1919.

Day of Show.	Cardiff, 1938.	Wolverhampton, 1937.	Bristol, 1936.	Newcastle, 1935.	Ipswich, 1934.	Derby, 1933.	Southampton, 1932.	Cardiff, 1919.
First ..	4,128	4,341	4,089	5,246	4,823	3,171	1,116	8,466
Second ..	18,980	21,536	14,873	25,985	23,137	21,684	8,165	45,096
Third ..	22,262	29,051	19,886	38,892	37,628	26,981	11,686	68,838
Fourth ..	11,882	10,395	17,825	19,466	21,165	13,573	11,997	36,292
Fifth ..	23,126	12,757	16,133	43,931	20,248	30,941	14,614	33,002
	80,378	78,080	72,806	133,520	107,001	96,350	47,578	191,694

The Y.M.C.A. again undertook the welfare work as well as the arrangements of Sports and Concerts for the stockmen during the period of the Show.

The Society owes its thanks to the Marquis of Bute for kindly placing the showyard site, "Pontcanna Farm," at its disposal, to the Lord Mayor of Cardiff (Alderman O. C. Purnell), to the Corporation Officials and particularly to Mr. Hubert

Alexander for the tremendous amount of detail work he undertook not only as Hon. Treasurer of the Local Fund but in every department where his local knowledge and long experience proved of such benefit.

The Royal Welsh Agricultural Society withheld its annual Show, and special classes were included in the Schedule to assist the members of that Society. They also contributed generously to the Local Fund and it is desired to acknowledge the friendly feelings and close co-operation that existed between the two Societies on the occasion of the visit of the "Royal Show" to South Wales. Visitors to the Show from Overseas were perhaps fewer than usual but in spite of this many prizewinning animals were purchased for shipment to our Dominions, Colonies and South America.

It is regrettable that the financial result was not more satisfactory, the Show resulting in a loss to the Society of £3,263.

T. B. Turner.

REPORT ON NEW IMPLEMENTS, CARDIFF SHOW, 1938.

List of Entries.

(1)	Improved Artificial Manure Distributor	Bamfords, Ltd.
(2)	Potato Conveyor	Cooch & Son.
(3)	Thatching Needle	John H. Darby.

The above three were awarded Silver Medals.

(4)	Pneumatic Tyres for Agricultural Tractors	Firestone Tyre & Rubber Co., Ltd.
(5)	Auto-Releaser Milking Plant ..	Gascoignes (Reading) Ltd.
(6)	Portable Tractor Winch ..	Fishleigh Rotary Cultivator Co., Ltd.
(7)	Munro Manure Distributor ..	E. H. Bentall & Co., Ltd.
(8)	Tractor Tyre Girdles	Kennedy & Kempe, Ltd.

Of the above entries only six were dealt with, as the Munro Manure Distributor and the Tractor Tyre Girdles were not available for tests at an appropriate time of the year. These two entries are deferred, and under para. 79 of the Society's regulations may be entered as new Implements at next year's Show.

The Mobile Grass Dryer which was deferred by the judges from last year was withdrawn from competition.

Of the six entries the judges considered that three only were entitled to Silver Medals.

I. Artificial Manure Distributor. Bamfords Ltd., Uttoxeter. Price £22 10*s.* 0*d.*

It is generally recognised that machines of the reciprocating grid type are amongst the most efficient in use to-day.

In the past, makers have used a rather complicated link-work mechanism for adjusting the movement of the plates. In some forms of this mechanism there are no fewer than five separate places at which wear might be expected to take place.

In the improved Bamford machine this link mechanism has been replaced by a much less vulnerable arrangement in the form of a double eccentric for adjusting the sowing rate. In this arrangement there are only two parts liable to serious wear.

Tests were carried out and a comparison was made between the improved pattern of Supreme Distributor, before and after 125 hours' work on the farm, and a machine of the earlier pattern which had done about 300 hours' work under ordinary farm conditions.

The tests were as follows :—

(1) Test to determine the reliability of calibration and evenness of sowing of the improved model in new condition.

(2) Farm trial of the improved model. The trial was of about 125 hours' duration and the general utility of the implement was observed.

(3) Examination of the improved model for wear, and retest of calibration and evenness, to determine whether any deterioration of performance had resulted from 125 hours of ordinary farm work.

(4) Calibration and evenness tests. and examination of wear, of old model, and comparison between the respective performances.

These tests proved that while in the improved model the distances moved by the front and rear plates were always equal and had not changed from their original values after 125 hours' work, the corresponding movements in the old model had changed considerably as the result of working, and moreover were not afterwards the same for both plates. Close examination of the machine showed quite clearly that the defects of the old model were due entirely to wear in the drive mechanism. Further tests were carried out which demonstrated that, as regards evenness of sowing, the performance of Bamford Supreme Distributor is of an unusually high order. The judges are of the opinion that the entrants' claims with regard to the improvements effected in their machine are well substantiated. A Silver Medal was accordingly awarded.

II. Cooch New Pattern Potato Conveyor. Messrs. Cooch & Son, Northampton. Selling Price from £8 15*s.* 0*d., according to size.*

This roller conveyor takes the place of the normal conveyor on which potatoes are hand-picked on their way from the sorter to the bagging frame. It consists of a series of wooden rollers 2 inches in diameter with 3-inch centres, connected together by two chains to form an endless belt. At each end of the rollers projecting spindles carry small pinions which mesh with toothed racks on the frame of the conveyor, causing the rollers to revolve on their axis as the conveyor moves forward. The potatoes are thus rotated several times during their journey along the conveyor. The drive is by belt from a pulley on the sorter. The conveyor can be fitted to any standard Cooch sorter. Under test a team of five men dealt with about 20 tons of potatoes at the rate of about 2 tons per hour. It was found easy to detect and remove all diseased potatoes; and the use of the rotating device resulted in an increased output of 2 tons

per day, producing a higher quality sample than the ordinary conveyor.

It was found almost impossible to block the conveyor, and when it was deliberately jammed the belt drive slipped and prevented any damage.

The conveyor is strongly built, the chains are adjustable and a reasonably long life can be expected. The judges consider that this device will simplify and shorten the operation of potato sorting and will in time supersede the old type of conveyor. They felt that this innovation, although very simple, would be of great assistance to potato growers, and awarded it a medal.

III. Thatching Needle. John H. Darby, Rugby. Price—Needle £1 1*s.*, *Reel* 2*s.* 6*d.*

Owing to a misunderstanding the judges were unable to see this needle demonstrated in the Show Yard last year. The entry was, therefore, deferred until the 1938 Show.

The instrument consists of a sickle-shaped steel needle pointed at one end and having an eye to take the twine. The needle is slotted in the neighbourhood of the eye so that the twine shall not cause undue resistance when the needle is pushed into the stack. A bracket is attached to the other end of the needle and through this passes a straight-pointed spear which is free to slide through the bracket. The point of the spear has a slotted hook. The needle is used as follows :—

The reel is filled with the binding cord and pieces of twine are cut to length for the stitches. The spear is pulled out to the full extent and a piece of twine placed in the slots across the eye of the needle. The starting position is with the handle pointing straight up the stack, lying close against the thatch and the point of the needle towards the thatch. The curved needle is pushed well into the stack at a point where the stitch is required, one end of the twine being held by the operator. The needle is then turned back until the handle is in a horizonal position. The spear is then pushed right home, and being afterwards withdrawn to the full extent brings back a loop of the twine on its hook. This loop is slipped off the hook, and the needle is withdrawn. The twine is now round a fairly large bunch of the stack and the two ends can be tied to the thatching cord.

A stitch is first put in as above at the end of the stack, and to this is attached the end of the thatching cord. When this has been made fast a few feet of the cord are unwound from the reel and pulled tight in position, the reel being fixed to the stack, holding the cord tight. The thatch is placed on the stack in the usual manner. A stitch is then put in and the ends tied to the cord. Stitches can safely be spaced at intervals of from

28 to 36 inches, whereas pegs would normally be necessary at intervals of from 14 to 18 inches.

A test was carried out by the Institute for Research in Agricultural Engineering, University of Oxford, and the Northamptonshire Institute of Agriculture, Moulton, near Northampton. The stitches, when once properly secured, could not be pulled out by hand, and the work done by the needle was found to be quite sound and undamaged after a period of two months, during which heavy gales occurred. The work done by a representative of the entrant indicated that when the needle was operated by an experienced man there would be no appreciable difference between the time taken in thatching with the needle and that required for ordinary thatching.

The judges were of the opinion that the following advantages were gained by the use of the needle :—

No pegs were necessary.

Stitches were only necessary at intervals of 28 to 36 inches, or at about double the normal intervals between adjacent pegs in ordinary thatching.

When the stitches were properly secured the work was quite waterproof and the stitched thatch was more secure than pegged thatch.

There is less opportunity for faulty work than with normal thatching.

The needle is well made and, provided it is properly looked after, should have a long life. It would be particularly useful where experienced thatchers are not available.

This is probably the smallest and least expensive device to be awarded a Silver Medal by the Society, but the judges consider it is worthy of an award.

IV. Firestone "Ground-Grip" Tyres for Agricultural Tractors. The Firestone Tyre and Rubber Co., Ltd., Great West Road, Brentford, Middlesex. Selling Price, Rear Cover and Tube for Fordson Tractor, £13 18*s*. 6*d*. *Complete set of Rear Wheels Covers and Tubes*, £48 2*s*. 0*d*.

The tyres are a development of the original "Ground-Grip" type brought out by the company in 1935. The tread pattern is unchanged, but the depth of the tread bars has been increased, particularly at the sides of the tyre, so as to give a greater width of tread in contact with the ground. Six-ply construction is used with two additional tread plies to give better support to the tread bars. The tyres are designed for operating pressures of 8 to 16 lb. per square inch.

It is claimed that these tyres possess advantages over other types due to the special arrangement of the tread bars, the

greater flexibility of the tyre foundation and their greater area of contact with the soil.

The tyres were tested under the following ground conditions, and comparison was made with two other standard types of tyre :—

1. Dry light-land stubble.
2. Stubble as above but in a very wet state during rain.
3. Dry, deeply cultivated fallow on medium land.
4. Fallow as above under rather wet conditions.

In each test the tractor hauled an electrical loading car, by means of which any constant load up to the stalling load of the tractor could be applied, and simultaneous readings of the average drawbar pull and wheel slips were made. The drawbar pull was measured by a hydraulic indicating dynamometer, while estimations of the wheel slip were based on a comparison between the distances travelled per revolution of the drive wheels under test and the distance travelled per revolution when the tractor was running light. Under the dry conditions the tests were repeated in both first and second gear of the tractor and at tyre inflation pressures of 12 and 8 lb. per square inch respectively. Under the very wet conditions only the middle gear of the tractor was used. In all cases wheels were tested as supplied, without adding wheel weights or other devices to increase adhesion.

These tests were very thoroughly carried out under the supervision of the Society's Engineer, and the following facts were very clearly proved :—

That under dry conditions the Firestone tyres were inferior in performance to both the other types in the sense that for any definite value of the drawbar pull there was appreciably more wheel slip with the Firestone tyres than when either of the other types was used. This conclusion was not affected by either the inflation pressure or the particular gear in which the test was carried out.

On the moist cultivated ground the performance of the Firestone tyres was intermediate between those of the other two types.

On the very wet stubble the performance of the Firestone tyres was much superior to that of one make and slightly superior to that of the other make, but the relative superiority of the Firestone was less evident when the pressures were reduced.

Under very wet conditions the Firestone tyres appeared to be more definite in their self-cleaning action, due possibly to the fact that their tread bars were less rigid. Taking the two tyres with the best performance in this respect, the self-cleaning did not become really effective until a certain limiting value of

the drawbar pull was reached. This limiting pull, however, was reached rather sooner with the Firestone tyres than with the other type, and in the case of the latter there was a range of intermediate pulls over which self-cleaning was indefinite, so that stalling was liable to result. On the other hand, if, as frequently happened, the pull could be maintained until the critical region was passed, the latter type tyres became definitely self-cleaning and would afterwards transmit an appreciably higher pull than the Firestone.

The judges are of the opinion that the Firestone " Ground-Grip " tyres have a more definite self-cleaning action than the other tyres considered and that they may therefore be less liable to stall under exceptionally bad conditions. They do not, however, consider that these tyres possessed sufficient general advantages over other types to merit an award.

V. Auto-Releaser Milking Plant. Messrs. Gascoignes (Reading) Ltd., Reading. Selling Price £110.

This plant is a development of other Gascoigne milking plants and in particular of the Auto-Recorder Plant which was entered for the Society's Silver Medal in 1934. It is claimed that the plant contains the following essentially new features :—

(1) A new type of milk control tap.

(2) A new type of pendulum pulsator designed to give a fixed speed of pulsation and to be independent, as regards its " drive," from the rest of the plant.

(3) A timing gear which brings a red light into operation four minutes after the start of milking any particular cow.

(4) A new type of releaser which releases the milk from the vacuum pipe without breaking the vacuum. This is stated to be less complicated in design and operation than any previous releaser.

The plant was in operation under test from February until June. During this period, which included spells of hot weather, the plant worked well and the cleanliness of the milk was of a very high standard. The new features were carefully watched and carried out their functions in a most satisfactory manner.

While the judges are of the opinion that considerable improvements have been made in the Gascoigne plant, they fail to see that it is appreciably more efficient than other plants which have recently been put on the market.

VI. Fishleigh Portable Tractor Winch. The Fishleigh Rotary Cultivator Co., Ltd., Devonshire House, Barnstaple. Selling Price £90.

This winch is intended for use with a low-powered tractor, to enable it to do such heavy work as mole drainage or timber haulage.

The winch is of normal design and is mounted on a two-wheel chassis which is provided with a tractor drawbar and a sprag anchor. The drive is taken from the power take-off of the tractor through a telescopic shaft and bevel gearing. Different gear ratios can be supplied according to the type of work for which the winch is required. The winch supplied for test was provided with a low gear for heavy work. The winch carries 70 yards of $\frac{1}{2}$-inch wire rope.

Owing to the very dry conditions prevailing at the time of test, it was not possible to carry out drainage operations. The winch was therefore given a working trial on timber haulage in Bagley Wood, near Oxford, and was afterwards subjected to a dynamometer test.

Tests were carried out at these loads :—

(1) 3,000 lb. pull. This is representative of the drawbar pull normally encountered in carrying out light mole drainage—for instance, with a 2-inch mole at 14 inches depth.

(2) 5,000 lb. pull. This is representative of heavy mole drainage—for instance, with a 3-inch mole at 18 inches depth.

(3) 10,000 lb. pull. This probably represents a pull in excess of anything likely to be experienced in ordinary agricultural or ditching operations.

All the tests were within the capacity of the winch itself, but with the medium pull there was a tendency for the winch to lift and tilt, and with the highest pull the sprag anchor could not be fixed to steady the winch.

The judges are of the opinion that the strengthening and widening of the base of the sprag anchor would largely increase the capacity of the winch, preventing the tilting and keeping the driving shaft from the tractor in line.

The only novel feature of the winch is that it is separately mounted so that it can be hauled by an ordinary agricultural tractor as a self-contained unit. While this is a very useful feature, since it would enable heavy drainage or timber-hauling work to be done with the ordinary light tractor equipment of a farm, the judges did not consider that there was sufficient novelty in the winch to justify the award of a medal.

On behalf of my fellow judge and myself I thank the Society's Consulting Engineer for the valuable assistance he has given us, and for the very comprehensive tests he has carried out, which greatly simplified our work.

HAROLD V. BLACKSTONE.

Woodstock,
Stamford.

REPORT OF THE STEWARD OF DAIRYING, CARDIFF SHOW, 1938.

MILK YIELD TRIALS.

CATTLE CLASSES 229 to 239 (inclusive).

THE Milk Yield Trials at the Cardiff Show were conducted on similar lines to those obtaining at Wolverhampton in 1937.

Of the 82 cows entered for the tests, only 57 put in an appearance. In most of the classes the average points obtained showed a decided increase.

In the Dairy Shorthorn class, J. Pierpont Morgan's "Aldenham Barrington Lass 7th" obtained 79·7 points, her milk yield being 70 lb. with an average fat percentage of 3·57.

Frank Sainsbury's "Wratting Honour 2nd" with a milk yield of 85·4 lb. and an everage fat percentage of 3·17 won the first prize in the Lincoln Red class.

In the small class of South Devons, John T. Dennis's "Winsor Snowdrop 5th" was awarded first prize.

Stuart Paul's Red Poll "Kirton Fantasy" obtained the premier honour in her class with 82·75 points.

In the Blue Albion class, C. H. Goodwin's cow "Marlene of Crossfields" obtained first prize. Her milk yield amounted to 53 lb. showing a fat percentage of 4·77.

There was a decided fall in the number of British Friesians tested. The first prize was won by T. G. Fairhead's "Bordeaux Bessie" with 102·85 points—the highest points in the 1938 tests. Her milk yield in 24 hours totalled 86 lb. 4 oz. with an average fat percentage of 3·54.

Of the two Ayrshire cattle tested W. H. Slater's "Craigley Grey 18th" obtained the first prize with 86·05 points, and the University of Edinburgh cow "Auchenbrain Miss Craig 67th" with 77·9 points was awarded the second prize.

In the Guernsey class the first prize was won by R. H. Brittain's "Gulpher Rouge" with a yield of 78 lb. of milk and an average fat percentage of 3·78.

Among the Jerseys, Lord Faringdon's "Madcap" obtained the first prize with a yield of 73 lb. 12 oz. and a total of 83·45 points.

In the Kerry class, W. A. Bertram Watney's cow "Loran Lady" obtained the first prize and was also awarded the Elmhurst Silver Challenge Cup.

Table I.—Milk Yield Classes at Cardiff, 1938.

Catalogue No.	Exhibitor.	Name of Cow.	Date of Birth.	Date of last Calf.	No. of days in Milk.	Date of last Service.	Milk Yield. Morning. Lb. oz.	Milk Yield. Noon. Lb. oz.	Milk Yield. Evening. Lb. oz.	Milk Yield. Total. Lb. oz.	Average Fat percentage.	Points. Milk.	Points. Fat over 3 per cent. × 10.	Points. Lactation.	Points. Service.	Points. Total.	Awards and Remarks.
Class 229		**Dairy Shorthorn.**		1938		1938											
987	King's College Farms ..	Holmescales Meadowsweet ..	June 7, 1931	June 12	22	—	26 8	18 0	16 4	60 12	3.31	60.75	3.10	Nil	Nil	63.85	Third Prize.
988	J. Pierpont Morgan ..	Aldenham Barrington Lass 7th ..	July 17, 1931	April 15	80	—	28 12	20 8	20 12	70 0	3.57	70.00	5.70	4.00	Nil	79.70	First Prize.
994	Viscount Hambleden ..	Anderson Wild Eyes 20th ..	March 4, 1932	May 17	48	—	32 0	21 0	20 0	73 0	2.92	73.00	—	.80	Nil	73.80	Fat below standard.
995	Mrs. K. Hollas ..	Iford Cowslip 7th..	Feb. 12, 1932	May 4	61	—	33 8	22 12	24 8	80 12	2.41	80.75	—	2.10	Nil	82.85	Fat below standard.
997	J. Pierpont Morgan ..	Aldenham Kirklevington Lady 6th	June 4, 1932	April 11	84	—	25 8	18 8	18 4	62 4	3.23	62.25	2.30	4.40	Nil	68.95	Second Prize.
1003	Sir William Hicking, Bt.	Brackenhurst Joan	May 20, 1933	June 8	26	—	28 0	18 12	19 8	66 4	2.51	66.25	—	Nil	Nil	66.25	Fat below standard.
1006	King's College Farms ..	St. Clere Daffodil 20th	Mar. 27, 1933	May 27	38	—	21 8	16 4	15 0	52 12	3.49	52.75	4.90	Nil	Nil	57.65	Fourth Prize.
Class 230		**Lincolnshire Red Shorthorn.**															
1080	Russell Wood	Bendish Nancy 32nd	Oct. 2, 1933	June 5	29	—	18 0	13 8	12 4	43 12	3.34	43.75	3.40	Nil	Nil	47.15	Insufficient points.
1081	Russell Wood	Bendish Woodland Rose 9th ..	Aug. 28, 1930	Jan. 15	170	Feb. 22	19 4	15 0	14 12	49 0	3.08	49.00	.80	12.00	9.00	70.80	Second Prize.
1084	Frank Sainsbury ..	Wratting Honour 2nd	Jan. 21, 1933	June 16	18	—	33 0	26 12	25 8	85 4	3.17	85.25	1.70	Nil	Nil	86.95	First Prize.
1085	Russell Wood	Bendish Nancy 31st	Sept. 27, 1933	June 11	23	—	18 8	15 0	15 8	49 0	4.02	49.00	10.20	Nil	Nil	59.20	Third Prize.
1090	Russell Wood	Bendish Cherry 54th	April 23, 1934	June 5	29	—	18 8	13 8	13 0	45 0	3.13	45.00	1.30	Nil	Nil	46.30	Insufficient points.
Class 231		**South Devon.**															
1118	R. W. Chaffe	Worswell Ida 5th	Feb. 24, 1932	June 10	24	—	21 8	15 12	14 0	51 4	3. 8	51.25	8.00	Nil	Nil	59.25	Second Prize.
1120	John T. Dennis ..	Winsor Snowdrop 5th	Mar. 19, 1932	Mar. 12	114	June 11	22 8	17 4	13 12	53. 8	4.26	53.50	12.60	7.40	Nil	73.50	First Prize.
Class 232		**Red Poll.**															
1170	Miss M. H. Bouverie, O.B.E.	Melton Mangrove	Mar. 7, 1932	May 12	53	—	28 4	18 4	19 12	66 4	3.67	66.25	6.70	1.30	Nil	74.25	Third Prize.
1172	Lt.-Col. Sir Merrik Burrell, Bt., C.B.E.	Knepp Prudence 19th	Oct. 10, 1932	June 10	24	—	26 0	21 4	21 8	68 12	3.36	68.75	3.60	Nil	Nil	72.35	Fourth Prize.
1174	J. G. Gray	Abbeycombe Royal Rosie 2nd ..	May 16, 1931	April 28	67	—	22 8	17 0	14 12	54 4	3.65	54.25	6.50	2.70	Nil	63.45	Reserve.
1178	Lady Loder	Leonardslee Blackberry	Oct. 10, 1932	June 4	30	—	16 12	14 0	14 0	44 12	3.49	44.75	4.90	Nil	Nil	49.65	Insufficient points.
1179	Stuart Paul	Kirton Fantasy	Aug. 15, 1932	April 3	92	June 9	33 4	20 0	18 8	71 12	3.58	71.75	5.80	5.20	Nil	82.75	First Prize.
1185	Lt.-Col. Sir Merrik Burrell Bt., C.B.E.	Knepp Minerva 25th	May 24, 1933	May 16	49	—	27 4	21 12	22 0	71 0	3.32	71.00	3.20	.90	Nil	75.10	Second Prize.
1187	Lady Denman	Parham Maureen	Jan. 21, 1933	May 17	48	—	22 0	16 12	15 4	54 0	3.0	54.00	—	.80	Nil	54.80	Insufficient points.
Class 233		**Blue Albion.**															
1231	T. H. Calderbank ..	Stow Doreen	Jan. 6, 1932	June 9	25	—	24 12	16 12	17 0	58 8	3.69	58.50	6.90	Nil	Nil	65.40	Second Prize.
1235	C. H. Goodwin ..	Marlene of Crossfields	Oct. , 1934	June 20	14	—	22 4	15 8	15 12	53 8	4.77	53.50	17.70	Nil	Nil	71.20	First Prize.
1236	C. H. Webster ..	Ivonbrook Poppy	Jan. 11, 1933	June 3	31	—	9 4	8 12	9 0	27 0	6.30	27.00	33.00	Nil	Nil	60.00	Third Prize.

Among the Dexters, Mrs. T. H. Peyton's "Colomendy Sybil" was awarded the first prize and the Dexter Cattle Silver Challenge Cup.

TABLE II.—*Average Results in Milk Trial Classes.*

No. of Cows competing.	Breed.	Days in milk.	Yield of milk.	Fat percentage.	Total Points.
			lb. oz.		
7	Dairy Shorthorn	51	66 9	3·03	70·44
5	Lincoln Red	54	54 6	3·33	62·08
2	South Devon	69	52 6	4·04	66·38
7	Red Poll	52	61 9	3·44	67·48
3	Blue Albion	23	46 5	4·61	65·53
4	British Friesian	57	87 12	3·07	92·10
2	Ayrshire	27	77 6	3·46	81·98
7	Guernsey	49	53 5	4·20	67·69
9	Jersey	113	49 11	4·51	72·98
5	Kerry	83	39 4	3·83	51·85
6	Dexter	73	31 3	3·42	41·09

Of the 57 animals tested—which represented 171 milkings—there were 33 samples of milk containing less than 3 per cent. of fat. 26 showed deficiency of fat in the morning's milk, 3 in the afternoon's milk and 4 in the evening's milk. On an average, the afternoon's milk proved to be the richest in fat. There were three animals which showed a deficiency of fat at each of the three milkings. The following table shows the average per cent. of fat in the milk obtained from different breeds :—

TABLE III.—*Showing Percentage of Fat in the Milk obtained from Various Breeds.*

Breed.	Morning.	Afternoon.	Evening.
Dairy Shorthorn	2·68	3·87	3·06
Lincoln Red	2·95	3·78	3·43
South Devon	3·32	4·80	4·25
Red Poll	2·84	4·00	3·70
Blue Albion	4·50	4·61	5·58
British Friesian	2·36	3·85	3·28
Ayrshire	2·62	4·05	3·57
Guernsey	3·49	4·72	4·81
Jersey	3·43	5·64	4·94
Kerry	2·99	4·64	4·04
Dexter	3·44	3·64	3·49

Table IV.—RESULTS OF BUTTER TESTS AT CARDIFF, 1938.

Class 240.—COWS OF GUERNSEY, JERSEY, KERRY OR DEXTER BREEDS.

Catalogue No.	Exhibitor.	Name of Cow.	Date of Birth.	Date of last Calf.	No. of Days in Milk.	Date of last Service.	Milk Yield in 24 hours.	Butter Yield.	Ratio, viz.: lb. milk to lb. Butter.	No. of Points for Butter.	No. of Points for Lactation.	No. of Points for Service.	No. of Points for Quality of Butter.	Total No. of Points.	Awards and Remarks.
		Guernsey.		1938		1938	Lb. oz.	Lb. oz.							
1475	R. H. Brittain ..	Gulpher Rouge	April 23, 1930	May 18	47	—	78 0	3 3¼	24·20	51·25	·70	Nil	10·00	61·95	Third Prize.
1477	W. Dunkels ..	Fernhill Pretty 8th ..	Nov. 28, 1933	April 19	76	—	46 8	1 13	25·70	29·00	3·60	Nil	10·00	42·60	—
1482	Eric H. Rose ..	Leweston Wilma 2nd ..	Nov. 16, 1932	June 12	22	—	50 4	2 14¾	17·20	46·75	Nil	Nil	10·00	56·75	H.C. and E.G.C.S. Cert. of Merit.
1484	Capt. L. Reginald Waud	Bradley Marigold ..	May 18, 1931	April 10	85	—	64 0	2 5½	27·30	37·50	4·50	Nil	10·00	52·00	H.C. and E.G.C.S. Cert. of Merit.
1485	Capt. Cosmo Douglas	Hazelby Ranee	Jan. 12, 1934	June 13	21	—	52 12	2 12¾	18·90	44·75	Nil	Nil	10·00	54·75	E.G.C.S. Cert. of Merit and H.C.
1489	Eric H. Rose ..	Leweston Rosey 5th ..	Nov. 4, 1934	June 19	15	—	32 12	1 10¾	19·70	26·75	Nil	Nil	10·00	36·75	—
1490	J. Brooke	Bealings Wild Rose 2nd	Jan. 16, 1935	April 18	77	—	48 12	1 12¾	27·10	28 75	3 70	Nil	9·00	41 45	H.C. and E.G.C.S. Cert. of Merit.
		Jersey.													
1549	Miss Marjory G. Barrow	Bluevein's Wonderful Girl	Oct. 18, 1933	May 8	57	—	36 4	1 9½	22·80	25·50	1·70	Nil	9·00	36·20	—
1554	Lord Faringdon ..	Madcap	Sept. 3, 1931	June 9	25	—	73 12	3 8¾	20·8	56·75	Nil	Nil	10·00	66·75	First Prize and E.J.C.S. Gold Medal and Reserve for Champion Medal.
1565	A. S. Lockwood ..	Normanby King's Ortona	Sept. 30, 1933	1937 Dec. 19	197	May 1	46 8	2 5¼	20·00	37·25	12·00	2·40	9·00	60·65	Fourth Prize and E.J.C.S. Bronze Medal.
1566	J. W. McCallum ..	Hauteville Orange ..	Aug. 12, 1933	1938 April 3	92	—	49 12	2 13¼	17·60	45·25	5·20	Nil	10·00	60·45	Fifth Prize.
1568	H. E. Mitchell ..	Chalvington Cis	Oct. 2, 1932	Jan. 30	155	April 12	44 4	2 2	20·90	34·00	11·50	4·30	8·00	57·80	H.C. and E.J.C.S. Cert. of Merit.
1570	H. S. Mountain ..	Groombridge Thrip's Bella	June 25, 1932	April 7	88	—	58 12	2 14	20·50	46·00	4·80	Nil	9·00	59·80	Reserve and E.J.C.S. Cert. of Merit.
1579	William E. Press ..	Deborah	Jan. 6, 1931	April 27	68	—	52 4	1 8¾	33·80	24·75	2·80	Nil	8·00	35·55	Ratio over 30.
1580	William E. Press ..	Wolvers Jenny	Nov. 26, 1931	Mar. 17	109	June 20	46 0	2 15	15·60	47·00	6·90	Nil	10·00	63·90	Second Prize and E.J.C.S. Silver Medal.

Table IV.—RESULTS OF BUTTER TESTS AT CARDIFF, 1938—*continued*.

Catalogue No.	Exhibitor.	Name of Cow.	Date of Birth.	Date of last Calf.	No. of Days in Milk.	Date of last Service.	Milk Yield in 24 hours.	Butter Yield.	Ratio, viz.: lb. milk to lb. Butter.	No. of Points for Butter.	No. of Points for Lactation.	No. of Points for Service.	No. of Points for Quality of Butter.	Total No. of Points.	Awards and Remarks.
		Class 240.—Cows of Guernsey, Jersey, Kerry or Dexter Breeds—*continued*.													
		Jersey.		1937		1938	Lb. oz.	Lb. oz.							
1589	H. S. Mountain ..	Groombridge Recorder's Berthella	Feb. 23, 1935	Nov. 17	229	Feb. 26	39 12	1 13$\frac{1}{4}$	21·70	29·25	12·00	8·80	9·00	59·05	H.C. and E.J.C.S. Cert. of Merit.
		Dexter.		1938											
1659	Rhys Llewellyn ..	Grinstead Princess 2nd ..	Aug. 11, 1933	Mar. 13	113	—	28 0	0 13	34·50	13·00	7·30	Nil	8·00	28·30	Ratio over 30.
1660	Rhys Llewellyn ..	St. Fagans Angela ..	Oct. 16, 1935	June 10	24	—	22 4	1 3$\frac{3}{4}$	18·20	19·75	Nil	Nil	9·00	28·75	Insufficient points.
		Class 241.—Cows of any Breed other than those mentioned in Class 240.													
		Longhorn.		1938		1938	Lb. oz.	Lb. oz.							
815	W. E. Swinnerton ..	Crickley Chestnut ..	Mar. 31, 1931	June 19	15	—	53 8	2 11$\frac{1}{2}$	19·70	43·50	Nil	Nil	8·00	51·50	Third Prize.
		Dairy Shorthorn.													
987	King's College Farms	Holmescales Meadowsweet	June 7, 1931	June 12	22	—	60 12	2 0$\frac{1}{4}$	29·90	32·50	Nil	Nil	7·00	39·50	Insufficient points.
988	J. Pierpont Morgan	Aldenham Barrington Lass 7th	July 17, 1931	April 15	80	—	70 0	2 8$\frac{1}{4}$	27·90	40·25	4·00	Nil	6·00	50·25	Fourth Prize.
994	Viscount Hambleden	Anderson Wild Eyes 20th	Mar. 4, 1932	May 17	48	—	73 0	1 9$\frac{3}{4}$	45·40	25·75	·80	Nil	4·00	30·55	Ratio over 30.
997	J. Pierpont Morgan	Aldenham Kirklevington Lady 6th	June 4, 1932	April 11	84	—	62 4	2 2$\frac{3}{4}$	28·70	34·75	4·40	Nil	5·00	44·15	Reserve.
1003	Sir William Hicking, Bt.	Brackenhurst Joan ..	May 20, 1933	June 8	26	—	66 4	1 9$\frac{1}{2}$	41·70	25·50	Nil	Nil	6·00	31·50	Ratio over 30.
1006	King's College Farms	St. Clere Daffodil 20th ..	Mar. 27, 1933	May 27	38	—	52 12	1 13$\frac{3}{4}$	28·50	29·75	Nil	Nil	9·00	38·75	Insufficient points.
		Lincolnshire Red Shorthorn.													
1080	Russell Wood ..	Bendish Nancy 32nd ..	Oct. 2, 1933	June 5	29	—	43 12	1 7$\frac{3}{4}$	29·50	23·75	Nil	Nil	8·00	31·75	Insufficient points.
1081	Russell Wood ..	Bendish Woodland Rose 9th	Aug. 28, 1930	Jan. 15	170	Feb. 22	49 0	1 8$\frac{3}{4}$	31·70	24·75	12·00	9·00	9·00	54·75	Ratio over 30.
1084	Frank Sainsbury ..	Wratting Honour 2nd ..	Jan. 21, 1933	June 16	18	—	85 4	2 12$\frac{1}{4}$	30·80	44·25	Nil	Nil	7·00	51·25	Ratio over 30.
1085	Russell Wood ..	Bendish Nancy 31st ..	Sept. 27, 1933	June 11	23	—	49 0	1 15	25·30	31·00	Nil	Nil	8·00	39·00	—

		South Devon.		1938		1938	Lb. oz.	Lb. oz.							
1120	John T. Dennis ..	Winsor Snowdrop 5th ..	Mar. 19, 1932	Mar. 12	114	June 11	53 8	2 4½	23·50	36·50	7·40	Nil	8·00	51·90	Second Prize.
		Red Poll.													
1174	J. G. Gray.. ..	Abbeycombe Royal Rosie 2nd	May 16, 1931	April 28	67	—	54 4	1 13	30·00	29·00	2·70	Nil	5·00	36·70	—
1187	Lady Denman ..	Parham Maureen ..	Jan. 21, 1933	May 17	48	—	54 0	1 9	34·70	25·00	·80	Nil	6·00	31·80	Ratio over 30.
		Blue Albion.													
1236	C. H. Webster ..	Ivonbrook Poppy ..	Jan. 11, 1933	June 3	31	—	27 0	1 10¾	16·20	26·75	Nil	Nil	7·00	33·75	Insufficient points.
		British Friesian.													
1302	W. Curtis & Son ..	Barwyke Myrtle Leaf ..	Aug. 30, 1931	May 21	44	—	89 8	2 6	37·70	38·00	·40	Nil	6·00	44·40	Ratio over 30.
1304	T. G. Fairhead ..	Bordeaux Bessie ..	Dec. 7, 1928	Feb. 2	152	May 29	86 4	3 4	26·50	52·00	11·20	Nil	8·00	71·20	First Prize and Championship Gold Medal.
1308	Francis N. Terry ..	Chebbard Heather ..	May 22, 1929	June 15	19	—	99 4	3 2½	31·50	50·50	Nil	Nil	7·00	57·50	Ratio over 30.
1309	Francis N. Terry ..	Shapwick Snap	Aug. 15, 1930	June 20	14	—	76 0	2 8	30·40	40·00	Nil	Nil	7·00	47·00	Ratio over 30.
		Ayrshire.													
1388	University of Edinburgh (Institute of Animal Genetics)	Auchenbrain Miss Craig 67th	Mar. 4, 1930	May 26	39	—	73 0	2 10¾	27·40	42·75	Nil	Nil	7·00	49·75	Fifth Prize.
1415	W. H. Slater ..	Craigley Grey 18th ..	Mar. 29, 1932	June 20	14	—	81 12	2 4½	36·10	36·25	Nil	Nil	4·00	40·25	Ratio over 30.

TABLE V.—MILK YIELD CLASSES FOR GOATS AT CARDIFF, 1938.

CLASS 252.—QUALITY.

No. in Catalogue.	Exhibitor.	Name of Goat.	Breed.	Date of Birth.	Date of last Kid.	No. of days in Milk.	Milk Yield. Morn.	Milk Yield. Even.	Milk Yield. Total.	Percentage of Fat. Morn.	Percentage of Fat. Even.	Points. Milk.	Points. Fat.	Points. Lactation.	Points. Total.	Awards and Remarks.
							Lb. oz.	Lb. oz.	Lb. oz.							
1676	Miss E. M. Gresley Hall	Webb Dauphinella ..	British Toggenburg	Mar. 3, 1936	Mar. 4, 1938	124	6 6	5 15	12 5	3.25	4.05	12.31	8.99	1.20	22.50	Reserve.
1678	Miss E. M. Gresley Hall	Webb Demeter ..	British Toggenburg	Mar. 19, 1933	Mar. 2, 1938	126	10 11	9 14	20 9	3.00	3.50	20.56	13.36	1.20	35.12	First Prize. Dua Purpose Challenge Certificate. Dewar Cup with No. 1734.
1679	Mrs. R. K. Morcom..	Cornish Frisky ..	British Toggenburg	Apr. 17, 1935	Mar. 8, 1937	495	5 12	5 10	11 6	3.00	3.10	11.37	6.94	3.60	21.91	Highly Commended.
1680	Mrs. Paine	Cornish Frolic ..	British Toggenburg	Apr. 17, 1935	May 20, 1937	422	4 14	3 12	8 10	3.40	3.00	8.62	5.52	3.60	17.74	—
1682	Miss K. Parker ..	Jacynth of Delamere	Saanen ..	Jan. 31, 1933	Mar. 7, 1938	121	3 11	3 6	7 1	3.70	3.70	7.06	5.22	1.20	13.48	—
1683	Miss K. Parker ..	Jean of Delamere ..	Saanen ..	Jan. 24, 1933	Mar. 24, 1937	479	4 0	3 14	7 14	4.40	4.00	7.87	6.61	3.60	18.08	—
1685	Miss E. Skidmore ..	Heddon Caroline ..	Saanen ..	Mar. 9, 1934	Mar. 29, 1938	99	5 9	4 14	10 7	3.50	3.85	10.43	7.67	.90	19.00	Commended.
1687	Miss C. Chamberlain ..	Whynot of Westons..	British Saanen	Apr. 26, 1934	Apr. 6, 1938	91	6 12	6 15	13 11	2.95	3.20			.90	—	Disqualified.
1689	Miss C. Chamberlain ..	Winning of Westons ..	British Saanen	Mar. 11, 1936	Mar. 14, 1938	114	6 10	6 8	13 2	2.60	3.60			1.10	—	Disqualified.
1690	Miss M. Window Harrison	Hartye of Weald ..	British Saanen	Apr. 30, 1933	Mar. 30, 1938	98	7 10	5 15	13 9	3.50	3.10	13.56	8.95	.90	23.41	Fourth Prize. Reserve Chamberlain Cup.
1691	Miss M. Window Harrison	Humble of Weald ..	British Saanen	May 26, 1934	Feb. 25, 1938	131	8 11	7 2	15 13	3.30	3.20	15.81	10.28	1.30	27.39	Second Prize. Chamberlain Cup. Reserve Dual Purpose Ch. Cert. Reserve Dewar Cup with No. 1719.
1692	Mrs. R. K. Morcom ..	Cornish Urchinette ..	British Saanen	Mar. 18, 1934	Mar. 31, 1938	97	5 3	4 5	9 8	4.15	4.45	9.50	8.17	.90	18.57	—
1693	Miss K. Parker ..	Silver of Delamere ..	British Saanen	Mar. 9, 1932	June 5, 1937	396	2 10	2 6	5 0	2.70	2.90			3. 6	—	Disqualified.
1694	Miss Pope	Heddon Silver ..	British Saanen	Mar. 11, 1935	Mar. 6, 1938	122	7 14	7 0	14 14	3.40	3.85	14.87	10.78	1.20	26.85	Third Prize.
1696	Miss Emily Skidmore	Heddon Sandalshoe ..	British Saanen	Mar. 6, 1936	Mar. 24, 1938	104	5 11	5 4	10 15	4.00	3.65	10.93	8.36	1.00	20.29	Highly Commended.
1697	Miss Emily Skidmore	Heddon Sorceress ..	British Saanen	Mar. 19, 1934	Mar. 3, 1938	125	5 2	4 12	9 14	4.20	3.80	9.87	7.90	1.20	18.97	—
1698	Miss Alexander ..	Stockwell Tzigane ..	British Alpine	Jan. 19, 1935	Feb. 21, 1938	135	5 5	4 10	9 15	4.10	4.25	9.93	8.29	1.30	19.52	Commended. Abbey Cup.
1699	J. R. Egerton ..	Didgemere Darkalette	British Alpine	Mar. 25, 1934	Apr. 15, 1938	82	5 12	5 6	11 2	3.10	3.55	11.12	7.39	.80	19.31	Commended.
1700	J. R. Egerton ..	Malpas Mariella ..	British Alpine	Mar. 21, 1936	Mar. 27, 1938	101	6 10	6 8	13 2	2.70	2.50			1.00	—	Disqualified.
1703	Miss K. M. Davies ..	Cambrian Beryl ..	Anglo Nubian	Feb. 26, 1936	Apr. 12, 1938	85	2 10	2 7	5 1	4.20	5.00			.80	—	Disqualified.
1704	J. R. Egerton ..	Malpas Merrilegs ..	Anglo Nubian..	May 27, 1935	Apr. 17, 1938	80	5 6	4 8	9 14	4.50	4.50	9.87	8.88	.80	19.55	Commended. Reserve Egerton Trophy.
1705	J. R. Egerton ..	Malpas Moya ..	Anglo Nubian	Mar. 16, 1936	Mar. 8, 1938	120	3 12	3 8	7 4	4.60	4.80	7.25	6.82	1.20	15.27	—
1706	J. R. Egerton ..	Malpas Musette ..	Anglo Nubian..	Mar. 14, 1936	Mar. 25, 1938	103	4 9	3 6	7 15	3.90	3.90	7.93	6.19	1.00	15.12	—
1707	Mrs. Paine	Tamar Amber ..	Anglo Nubian..	Mar. 28, 1932	Mar. 30, 1938	98	2 11	2 8	5 3	4.00	4.80			.9	—	Disqualified.
1708	Miss K. Pelly ..	Theydon Bellaritza ..	Anglo Nubian..	May 24, 1936	Mar. 31, 1938	97	5 11	5 11	11 6	4.25	5.50	11.37	11.09	.90	23.36	Fifth Prize. Pomeroy Cup, Egerton Trophy.

							Lb. oz.	Lb. oz.	Lb. oz.							
1710	Miss K. Pelly ..	Theydon Butterkin ..	Anglo Nubian..	Apr. 7, 1935	Apr. 13, 1938	84	4 6	4 6	8 12	4.55	5.00	8.75	8.36	.80	17.91	
1711	Miss K. Pelly ..	Theydon Judy ..	Anglo Nubian..	Mar. 16, 1933	Apr. 15, 1938	82	5 12	5 0	10 12	4.50	4.65	10.75	9.84	.80	21.39	Highly Commended. Reserve Pomeroy Cup.
1713	J. R. Egerton ..	Malpas Meda ..	British.. ..	June 8, 1936	June 1, 1938	35	6 0	6 0	12 0	3.55	3.35	12.00	8.28	.30	20.58	Highly Commended.
1714	Mrs. R. K. Morcom..	Cornish Dizzy ..	British.. ..	May 2, 1936	Mar. 3, 1938	125	5 13	5 4	11 1	3.60	4.00	11.06	8.41	1.20	20.67	Highly Commended.
1715	Mrs. R. K. Morcom..	Cornish Playful ..	British.. ..	Feb. 21, 1933	Mar. 3, 1938	125	5 4	4 10	9 14	3.60	3.50	9.87	7.01	1.20	18.08	—
1716	Mrs. R. K. Morcom ..	Cornish Puffin ..	British.. ..	May 5, 1936	May 9, 1938	58	5 13	5 12	11 9	4.15	3.70	11.56	9.07	.50	21.13	Highly Commended.
1717	Mrs. Paine	Tamar Ruffle.. ..	British.. ..	Mar. 10, 1933	May 17, 1938	50	8 0	8 0	16 0	2.90	4.25	—	—	.50	—	Disqualified

Class 253.—QUANTITY.

No. in Catalogue.	Exhibitor.	Name of Goat.	Breed.	Date of Birth.	Date of last Kid.	No. of days in Milk.	Milk Yield. Morn.	Milk Yield. Even.	Milk Yield. Total.	Points. Milk.	Points. Fat.	Points. Lactation.	Points. Total.	Awards and Remarks.
1675	Miss Alexander ..	Kettleness	Toggenburg ..	Apr. 3, 1933	Apr. 17, 1938	80	4 1	3 15	8 0	8.00		.80	8.80	—
1676	Miss E. M. Gresley Hall	Webb Dauphinella ..	Toggenburg ..	Mar. 3, 1936	Mar. 4, 1938	124	6 6	5 15	12 5	12.31		1.20	13.51	Highly Commended.
1678	Miss E. M. Gresley Hall	Webb Demeter ..	British Toggenburg	Mar. 19, 1933	Mar. 2, 1938	126	10 11	9 14	20 9	20.56		1.20	21.76	First Prize.
1679	Mrs. R. K. Morcom..	Cornish Frisky ..	British Toggenburg	Apr. 17, 1935	Mar. 8, 1937	495	5 12	5 10	11 6	11.37		3.60	14.97	Fifth Prize.
1680	Mrs. Paine	Cornish Frolic ..	British Toggenburg	Apr. 17, 1935	May 20, 1937	422	4 14	3 12	8 10	8.62		3.60	12.22	Commended.
1682	Miss K. Parker ..	Jacynth of Delamere	Saanen ..	Jan. 31, 1933	Mar. 7, 1938	121	3 11	3 6	7 1	7.06		1.20	8.26	—
1685	Miss Emily Skidmore	Heddon Caroline ..	Saanen ..	Mar. 9, 1934	Mar. 29, 1938	99	5 9	4 14	10 7	10.43		.90	11.33	—
1687	Miss C. Chamberlain ..	Whynot of Westons..	British Saanen	Apr. 26, 1934	Apr. 6, 1938	91	6 12	6 15	13 11	13.68		.90	14.58	Reserve.
1689	Miss C. Chamberlain ..	Winning of Westons ..	British Saanen	Mar. 11, 1936	Mar. 14, 1938	114	6 10	6 8	13 2	13.12		1.10	14.22	Highly Commended.
1690	Miss M. Window Harrison	Hartye of Weald ..	British Saanen	Apr. 30, 1933	Mar. 30, 1938	98	7 10	5 15	13 9	13 56		.90	14.46	Highly Commended.
1691	Miss M. Window Harrison	Humble of Weald ..	British Saanen	May 26, 1934	Feb. 25, 1938	131	8 11	7 2	15 13	15.81		1.30	17.11	Second Prize.
1692	Mrs. R. K. Morcom..	Cornish Urchinette ..	British Saanen	Mar. 18, 1934	Mar. 31, 1938	97	5 3	4 5	9 8	9.50		.90	10.40	—
1693	Miss K. Parker ..	Silver of Delamere ..	British Saanen	Mar. 9, 1932	June 5, 1937	396	2 10	2 6	5 0	5.00		3.60	—	Disqualified
1694	Miss Pope	Heddon Silver ..	British Saanen	Mar. 11, 1935	Mar. 6, 1938	122	7 14	7 0	14 14	14.87		1.20	16.07	Fourth Prize.
1696	Miss Emily Skidmore	Heddon Sandalshoe ..	British Saanen	Mar. 6, 1936	Mar. 24, 1938	104	5 11	5 4	10 15	10.93		1.00	11.93	—
1697	Mis; mily Skidmore	Heddon Sorceress ..	British Saanen	Mar. 19, 1934	Mar. 3, 1938	125	5 2	4 12	9 14	9.87		1.20	11.07	—
1699	J. R. Egerton ..	Didgemere Darkalette	British Alpine..	Mar. 25, 1934	Apr. 15, 1938	82	5 12	5 6	11 2	11.12		.80	11.92	—
1700	J. R. Egerton ..	Malpas Mariella ..	British Alpine	Mar. 21, 1936	Mar. 27, 1938	101	6 10	6 8	13 2	13.12		1.00	14.12	Highly Commended.
1713	J. R. Egerton ..	Malpas Meda ..	British.. ..	June 8, 1936	June 1, 1938	35	6 0	6 0	12 0	12.00		.30	12.30	Commended.
1714	Mrs. R. K. Morcom..	Cornish Dizzy ..	British.. ..	May 2, 1936	Mar. 3, 1938	125	5 13	5 4	11 1	11.06		1.20	12.26	Commended.
1716	Mrs. R. K. Morcom..	Cornish Puffin ..	British.. ..	May 5, 1936	May 9, 1938	58	5 13	5 12	11 9	11 56		.50	12.06	Commended.
1717	Mrs. Paine	Tamar Ruffle.. ..	British.. ..	Mar. 10, 1933	May 17, 1938	50	8 0	8 0	16 0	16.00		.50	16.50	Third Prize.

BUTTER TEST TRIALS.

Classes 240 and 241.

Of the 24 animals entered in Class 240 (open to Guernsey, Jersey, Kerry and Dexter Breeds), only 18 competed.

Three cows failed to qualify—two because the ratio was over 30, and the third owing to insufficient points.

R. H. Brittain's "Gulpher Rouge" was awarded the Fernhill Challenge Cup in the Guernsey Class.

Lord Faringdon's "Madcap" obtained the premier award in this class. The cow was also the Reserve for the Championship Gold Medal.

In Class 241, 21 cows were tested.

The first prize was awarded to T. G. Fairhead's cow "Bordeaux Bessie." This animal also won the Champion Gold Medal for the cow obtaining the highest number of points in both classes. From 86¼ lb. milk, 3¼ lb. butter was obtained, giving a butter ratio of 1 : 26·5.

Several animals failed to qualify, owing to the Ratio being over 30, or else failing to obtain sufficient points.

Table VI.—*Average results of Breeds in Butter Tests.*

No. of cows competing.	Breed.	Days in Milk.	Yield of Milk.		Yield of Butter.		Butter ratio.	Points.
			lb.	oz.	lb.	oz.	lb.	
7	Guernsey	49	53	5	2	6	22·89	49·46
9	Jersey	113	49	11	2	6	21·49	55·57
2	Dexter	69	25	2	1	0½	26·25	28·53
1	Longhorn	15	53	5	2	11½	19·70	51·50
6	Dairy Shorthorn . .	50	64	3	1	15½	33·65	39·12
4	Lincoln Red . .	50	56	12	1	15	29·33	44·19
1	South Devon . .	114	53	8	2	4½	23·50	51·90
2	Red Poll	58	54	2	1	11	32·25	34·25
1	Blue Albion . .	31	27	0	1	10¾	16·20	33·75
4	British Friesian . .	57	87	12	2	13	31·50	55·03
2	Ayrshire	27	77	6	2	7½	31·70	45·00

THE WORKING DAIRY.

The work carried out in the working dairy was very similar to that obtaining at previous Shows. The dairy staff was fully occupied during the period of the Show, and I wish to express my appreciation of the loyal assistance rendered by all concerned.

The entries for the butter-making competitions numbered 143. The judges in charge of this department expressed their satisfaction with the excellence of the work done.

THE POULTRY SECTION.

I wish to place on record the able assistance which Mr. E. H. Walters rendered in this section.

RICHARD H. EVANS.

Barclay's Chambers,
Pwllheli, North Wales.

THE AGRICULTURAL EDUCATION AND RESEARCH EXHIBIT AT THE CARDIFF SHOW, 1938.

THE exhibit at the Cardiff Show was a combined effort in which many authorities and institutions took part. Amongst these were the County Authorities of Glamorgan and Monmouth, the Advisory Department of the University College, Cardiff, the Agricultural Department of the University College, Bangor, the National Institute of Agricultural Botany, Cambridge, the Agricultural Economics Department of the University College, Aberystwyth, and the Welsh Plant Breeding Station, Aberystwyth.

Unfortunately the writer is not in a position to describe in detail the contributions made by authorities and institutions other than the Welsh Plant Breeding Station, and is obliged, as an interested person, to describe the latter quite briefly and without comment.

The contribution of the Welsh Plant Breeding Station may be considered under four headings :

A.—CEREAL BREEDING.

In this section it was intended particularly to show some of the newer varieties of both wheat and oats, as well as other existing commercial varieties, and for this purpose both Cambridge and Aberystwyth varieties were included. The exhibit took the form of specimen ears together with grain samples, and these were arranged in groups as nearly as possible according to their suitability for soils of various grades of fertility.

Wheat.—The Cambridge wheats shown were Holdfast, Yeoman II, and Little Joss, while from Aberystwyth two pure lines of the old Welsh "land" variety, *Hen Gymro* (Old Welsh) were included. The Cambridge varieties represented the modern wheats suitable for growing on various grades of typical wheat land. The two Aberystwyth varieties, on the other hand, represented a type of wheat that has retained favour with farmers in parts of Wales where the conditions would ordinarily be considered to be entirely unsuitable for successful wheat growing. The old land variety *Hen Gymro*, when studied in detail, was found to consist of numerous physiological and morphological types, although these conformed to a general type with a rather long, fine and weak straw and a lax ear.

One of the two pure lines shown, Aberystwyth S.70, is stouter and stiffer in the straw than the average for *Hen Gymro*, and the

grain is slightly larger. The ear is beardless and rough and the grain red. The other variety, S.73, is less stiff in the straw; the ear is white chaffed, smooth and beardless, and the grain red but relatively very small.

The *Hen Gymro* wheat, despite its weak straw, has retained its popularity in parts of Wales, apparently because it is capable of producing, even under very adverse conditions, a grain sample that can be milled for home breadmaking.

Oats.—The Cambridge white winter oat Resistance was shown along with three varieties of winter oats produced at the Welsh Plant Breeding Station. The latter are known as Aberystwyth S.81, S.82 and S.147. S.81 is very winter-hardy, highly resistant to stem eel-worm, and is suitable for cultivation on soils of medium to good fertility. The very stiff straw of S.82 renders it suitable for land of high fertility. It is slightly late in ripening. S.147 is medium early, possesses a good standing straw and is therefore suitable for land of good fertility. The grain of this variety is of exceptionally good quality. All three varieties are white grained.

Three spring varieties produced at Aberystwyth were also shown. Aberystwyth S.171 (*Ceirch Llwyd Cwta*) is derived from a cross between the "hairy oat" *Avena strigosa*, and the "short oat," *Avena brevis*. It resembles *A. strigosa* in yielding capacity, both in regard to straw and grain, but has the advantage that the long points of the husk are missing. It is suitable for poor upland conditions under which *A. strigosa* is usually grown, and is highly resistant to both loose and covered smut.

The variety S.175 is white-grained and early, and is suitable for cultivation on soils of medium fertility. It gives high yields of both straw and grain under such conditions. S.84 is also a white-grained variety, slightly late in ripening, but owing to its stiff straw does well on land of high fertility.

B.—The Breeding of Herbage Plants.

This was probably the least satisfactory section, particularly from the exhibitor's point of view, because it was extremely difficult, at the time the Show was held, to find suitable material; in any case the work of the breeders in this section can only be satisfactorily demonstrated on the actual breeding grounds, or else, in the case of established strains, by means of plots in the field.

An attempt was, however, made to bring together in pots individual plants showing the general characteristics of some of the types that constitute the new grass and clover strains produced at Aberystwyth. These plants of perennial ryegrass, cocksfoot, timothy, red clover and white clover were arranged

side by side with plants representing the ordinary cultivated (or commercial) types normally available.

C.—Seed Production.

New strains of grasses and clovers are obviously useless unless they can reach the ordinary farmer, and with the production of such new strains the question of multiplication has become an urgent problem. Most of the new strains are of the leafy, persistent type which normally produces less seed than the more stemmy cultivated types. It has, therefore, been necessary to investigate methods of seed production in order that the highest possible yield of seed may be obtained consistent with the retention of the plant type characteristic of each strain. Moreover, in order that such investigations and the multiplication of the strains themselves may be carried out by the Plant Breeding Station itself, the areas selected must be fairly accessible from Aberystwyth. Such areas have been found mainly in the Welsh Border counties, where grass-seed production was not formerly a feature of the normal husbandry; it has therefore been necessary to test out various methods of cultivation, management, manuring and harvesting under these particular conditions.

The exhibit at the Show could not possibly cover all aspects of the work, but sheaves of pedigree strains of perennial ryegrass, cocksfoot, timothy, red fescue, meadow fescue and tall fescue, all grown in these seed-production areas, were shown. There were also enlarged photographs showing the production of a cocksfoot seed crop, step by step, from the seed sown to the cleaned seed. Other enlarged photographs showed crops, mainly in the stook, of seed crops of pedigree perennial ryegrass, cocksfoot, timothy and red fescue harvested by machinery at altitudes up to more than 1,000 ft. Seed from such crops, grown on contract in the Welsh and English counties, was shown in exhibition jars.

In adverse seasons the problem of conditioning the seed without loss of germinating capacity and vigour is an important one. Seed with an initial moisture content above a particular "norm" for each species deteriorates rapidly during storage, and the Davies Moisture Meter (designed and constructed at Aberystwyth), by means of which the moisture content of any seed sample can be quickly and reliably determined, was demonstrated at the Show. In addition, charts were shown which gave graphical representations of moisture relations: (*a*) calibration of the Davies Moisture Meter for various grass species; (*b*) the effect of storage upon the germinating capacity of grass seeds of varying initial moisture content; and (*c*) the effect of natural and artificial drying upon germinating capacity.

D.—Grassland.

In this section a wide field was covered. Turves 3 feet by 2 feet were brought together and were laid out in an ideal setting in front of the Education Pavilion. They represented existing types of grasslands in Wales, together with sample of plots included in various types of experiments connected with grassland husbandry.

One series of turves (arranged as small beds) illustrated the chief pasture types found in Wales, from typical swards of perennial ryegrass and white clover to the *Molinia* and other pasture types of the uplands. An accompanying map showed the approximate distribution of these types, while the relative acreage covered by each type was represented in chart form.

A second series of turves demonstrated the effects of lime and of various manures, including animal droppings ("stock nitrogen"), upon the growth and the botanical composition of young and of established swards under different conditions of soil and altitude. It was shown that the sharpest responses are usually given by young swards; that lime and phosphate usually have little effect upon old hill swards where white clover is absent; but that, where a small representation of white clover exists in the original sward, even under very poor conditions, a remarkable change follows the application of lime and phosphate. The turves concerned with the effect of animal droppings illustrated the fact that even good land may become impoverished by day-grazing alone, while night-grazing fields near the homestead reap the benefit.

The effect of different methods of management upon the botanical composition of young swards was shown by means of two series of turves in their fifth harvest years (from sowing). The two series represented (*a*) ordinary seeds, and (*b*) leafy strains. The treatments illustrated were (1) mowing for hay each season; (2) grazing regularly throughout the year except for a period in the autumn; (3) as (2), but with lenient grazing in the autumn; (4) normal grazing throughout the year. The main difference between the ordinary seeds and the leafy strains was the far greater development of weeds in the swards of the former. It was shown that long rest periods, especially in the autumn, greatly encourage cocksfoot, while perennial ryegrass and white clover become dominant under regular rotational grazing.

Four series, of five turves each, showed the effect of management and grazing on four types of old pasture. The systems of management ranged from continuous grazing, at the one extreme, to "neither grazed nor mown" at the other. Continuous hard grazing favoured the fine grasses and clovers, while light grazing,

and particularly the absence of either grazing or mowing, encouraged the coarser types of grasses and weeds.

The seeds-mixtures turves were intended to show differences in the results from different strains within a species. The first series represented pastures in their second, fourth and sixth harvest years. The main comparisons were between Aberystwyth S.23 and ordinary perennial ryegrass, and between Aberystwyth S.26 and ordinary cocksfoot. Red-clover swards in their second and third harvest years were also included. In the experiments represented, ordinary broad red clover had behaved almost as a strict biennial, while the ordinary Montgomery type, and especially Aberystwyth S.123, had proved much more persistent and had produced heavier crops of hay.

Other seeds-mixture turves, from swards varying from one to thirteen years old, showed the effect of leafy strains, compared with their ordinary commercial counterparts, under ordinary farm management. Swards more than four years old, from ordinary seed, contained less than 10 per cent. of sown species, whereas many of those sown with the improved strains showed more than 50 per cent.

Where complicated and simple seeds mixtures had been tested side by side turves showed that, by the third or fourth season, the swards differed very little in botanical composition. One or two of the species had become dominant, and the other constituents of the complicated mixtures had disappeared.

Turves showing successful sward formation on land of (*a*) high fertility, (*b*) average fertility and (*c*) low fertility were also exhibited, together with the details of the seeds mixtures used in each case.

Finally, turves were shown to illustrate methods used in the improvement of practically derelict hill land. The original swards were shown side by side with the improved ones. Without cultivation of any kind, and in the absence of white clover, neither lime nor phosphates had had an appreciable effect, but where such original swards had contained traces of white clover, or where white clover plants had been produced by sowing, there was a marked improvement.

The most rapid and the most satisfactory improvement on such land is obtained, as was shown by the turves exhibited, by cultivation (ploughing or rotary tillage), together with re-seeding and manuring—particularly with phosphates. The application of basic slag and lime greatly facilitates the establishment of sown seeds, while nitro-chalk, although by itself it does not encourage establishment, has proved very valuable in conjunction with phosphates or lime.

T. J. Jenkin.

Welsh Plant Breeding Station,
Aberystwyth.

THE FORESTRY EXHIBITION AT THE CARDIFF SHOW, 1938.

THIS section was held under the Stewardship of Lord Hastings (who was unavoidably absent), Mr. H. A. Benyon and Mr. A. D. C. Le Sueur. It was, as usual, very well arranged.

On one side of the allotted area a large tent housed all the indoor exhibits; on another, under a covered awning, there were demonstrations of besom-making by Mr. W. H. West, of Mulford Hill, Basingstoke; of sheep-crib and hurdle making by Mr. G. J. Hales, of Wellow, Bath; and of hurdle, rack and thatch pegs by Mr. A. Wicks, Hullavington, Chippenham. Here, too, Mr. B. A. Buckman, of Harfield, Sussex, was exhibiting axes and cross-cut saws of various types, and demonstrating their use and the best methods of setting and filing them.

Mr. Buckman has had practical experience in Canada, where the importance of this work is appreciated more than it is here. A great amount of time and energy is wasted on many estates in this country through inefficient and badly sharpened tools.

Erected immediately in front of the Main Tent were the gates, wickets and fencing entered for competition, and adjoining these the Duke of Montrose was exhibiting the "Mobyl" charcoal kiln and a Fordson tractor fitted up to run on the home-made charcoal.

Beyond the gates, an area was set apart for a demonstration of pitprop work by Welsh miners. This demonstration unfortunately did not take place until late in the week.

Inside the Main Tent were the only two classes open to competition. These were unfortunately very poorly filled, there being only two competitors in each class for planks of hardwood and conifers.

In CLASS 1, for *Specimens of Oak, Elm, Ash, Spanish Chestnut, Sycamore and Beech,* Major J. A. Herbert, M.P., Llanover Estate, was awarded a Silver Medal. His exhibit was of very fair quality with the exception of the Sycamore, which showed signs of stain. The most noticeable plank was one of Spanish Chestnut which had an unusually wavy grain. This timber was grown on gravel soil at an average elevation of 350 feet.

Captain A. M. Talbot Fletcher, Saltoun Hall, Midlothian, was awarded a Bronze Medal for a set of planks from trees grown on heavy loam at an approximate elevation of 300 feet. His Elm and Oak planks, though of good quality, tapered too sharply to permit of economical conversion, and the Sycamore was stained. His Ash plank had unfortunately been damaged in railway transit.

In CLASS 2, for *Specimens of Larch, Silver Fir, Douglas, Spruce and Pine timber,* each competitor omitted one species, Major

Herbert showing no Silver Fir, and Captain Fletcher no Douglas Fir. The Llanover Estate was awarded the Silver Medal for four planks grown on gravel soil at an elevation of 300 feet, and Captain Fletcher was awarded a Bronze Medal. There was little to choose between the two exhibits, but Captain Fletcher's Scots Pine showed signs of Blue Stain.

The non-competitive exhibits comprised a section entitled " From Seed to Pitwood " exhibited by the Plymouth Estates. This demonstrated, by means of seeds, plants, models of various aged plantations and actual pitprops in position, the life story of mining timber. This was very well arranged and showed much ingenuity. For this exhibit and a gate, not entered for competition, Lord Plymouth was awarded a Silver Medal and also the Special Silver Gilt Medal.

Silver Medals were also awarded to the following :—

(1) Robert Neil Chrystal, M.A., D.Sc., of the Imperial Forestry Institute, Oxford, for " Insects of the British Woodland ".

This exhibit comprised specimens, models, sections of twigs and logs, original drawings, photographs, etc., and depicted most clearly the damage done by insect pests to woodlands, and their life histories. This was one of the most interesting and instructive stands, and its preparation had obviously entailed a very large amount of work. Everyone interested in woodlands should obtain the book on which this exhibit was based.

(2) The Duke of Montrose, for a portable charcoal kiln, and a Fordson tractor running on the charcoal produced and fitted with a gasogene producer plant at present manufactured only in France.

The total weight of the plant is about 5 cwt. and the consumption of charcoal 10 lb. per hour on an average load. The adaptation involves a loss in power, as compared with oil, of 20 per cent.; but there is the great advantage of there being no oil dilution in the sump. The tractor is started on petrol. The advantages of the kiln, which has only recently, and after extensive tests, been put on the market, are that it can be taken to any site on a farm cart, is quickly assembled, and that its operation can be mastered, in a few days, by an unskilled man. It will convert any wood (even softwood thinnings) to charcoal, though the quality of the resulting fuel naturally depends on the material used. A battery of six kilns, which would employ two men, would probably give the best results, but it is possible to work one kiln with one man, who can divide his time between it and other jobs near by. A battery of six kilns should convert 12 cords of wood per week into 2½ tons of charcoal valued at £12 10*s*. 0*d*. As cordwood is almost unsaleable in many districts, owing to the cost of transport, such kilns would be of great assistance to woodland owners. Particulars of this kiln

are obtainable on application to Transportable Charcoal Kiln, Limited, 48, Dover Street, London.

(3) The Long Ashton Research Station, Bristol, for their Bat Willow Stand.

Amongst other things Mr. Hutchinson showed different sections of Willow to prove the advantage of planting rooted as against unrooted sets.

(4) The Department of Botany, National Museum of Wales, for a wonderful collection of 56 Welsh-grown planks, varying in size from one of Ivy, six inches wide, to one of Sequoia of three feet two inches diameter. Two planks each of Sequoia, Oak and Spanish Chestnut, all of exceptional quality, were included in this display.

(5) The Royal Agricultural College, Cirencester, for an exhibit under the legend " Good men are liable to make mistakes and are sometimes warmly engaged in error " (*Locke*).

The above notice called attention to an exhibit which showed the error of planting spruce on unsuitable soil, of bad mixtures in planting, and of mistakes in thinning. Mr. Le Sueur, who had arranged this exhibit, also showed, in a very clear and instructive manner, the way in which healthy trees get infected with Elm Disease through the agency of beetles, which breed in logs.

Mr. Le Sueur was also responsible for illustrating, on the Chartered Surveyors' Institute Stand, the uses of coppice wood, and for displaying a collection of eighteen different types of billhooks used in different districts.

(6) The Timber Development Association, for a large stand on which they were showing photographs connected with woodland subjects together with plans of wooden houses, timber samples, veneers of English timber, planks and literature. Outside the tent the Association had erected a small section of the exterior wall of a wooden house, showing the correct way to incorporate the inner lining, which was nailed diagonally to the framing, waterproof paper, and " Shiplap " outer cover.

Mr. R. C. B. Gardner was awarded a Bronze Medal for his fine display of Tree Photographs. He also represented the Royal English Forestry Association, the British Wood Preserving and Home-grown Timber Associations. No one has done more to introduce new and useful tools to foresters than he has by his exhibits at Agricultural Shows, and woodland owners should be very grateful to him for his work on their behalf.

Gates.

In the classes for Gates and Wickets there were only four competitors and, generally speaking, the entries were not up to the standard which one expects to see at the " Royal ". All

fastenings were of iron and in several cases were of a most inconvenient type, which allowed for no sagging in the gate. Where wooden latches are not used, the iron spring catch, which is most efficient, should take their place. A further point is that, in these days of modern saws, the planing of field gates is unnecessary, and should not be encouraged at Shows. It adds considerably to the cost, and is seldom done in practice.

It would be better for this exhibit if it were possible to have three classes instead of two for sawn gates, viz. :—

(*a*) Oak gates of field pattern, but planed and better finished, suitable for drives and farm approaches, and costing something like 40*s*.

(*b*) Oak gates for general farm use, to be shown unplaned and costing up to 30*s*.

(*c*) Gates for farm use, other than all oak, costing up to 25*s*.

No gate should be less than 10 feet wide. All exhibitors should have to state, without detail, the total cost of the gate shown, and should be prepared to supply, at the stated price, at least one dozen or more if required to do so by the judge. This would do something to prevent the exhibits being too well finished for their class.

The awards were as follows :—

Class 3. *Oak Field Gate.*

Major Herbert was awarded the Silver Medal for a well-made gate of good quality which was, however, much too light to stand against heavy stock. This was fitted with a spring latch and was well hung.

The Bronze Medal was awarded to the Dinam Estates, for a six-barred gate. This was a very strong but awkward-looking gate, the top rail being tapered from the centre instead of from the end, thus giving it a hump-back appearance. Top rails cut in this way mean waste. It was fitted with a small iron latch which would be difficult to open unless on foot.

Captain Talbot Fletcher showed an unusual design of gate which was of excellent material and workmanship, but the lower bars were $1\frac{1}{2}$ by $3\frac{1}{2}$ inches and untapered, which arrangement is contrary to the accepted practice of keeping the " head " lighter than the " heel ".

Class 4. *Field Gate made of Timber other than Oak.*

The Silver Medal was awarded to Major Herbert, for a well-made Larch gate of similar pattern to that in Class 3. The Bronze Medal went to the Dinam Estates.

Class 5. *No entry.*

CLASS 6. *Wicket or Hunting Gate.*

The Silver Medal was awarded to Major Herbert for a well-made oak wicket fitted with spring latch. The Bronze Medal was awarded to Captain Fletcher for a well-made oak wicket with a two-way catch. The lower gate-hook was fitted with a special device to lift the wicket when opening; the iron strapping on the gate was unnecessarily heavy.

CLASS 7. *Stile.*

The Silver Medal was awarded to the Dinam Estates for a strong well-made oak stile, Major Herbert getting the Bronze Medal for a larch one.

CLASS 8. *Field Fencing of Home-grown Timber.*

The Dinam Estates were awarded the Silver Medal for a strong oak-post and larch-rail fence. The height was 3 ft. 10 in. The posts, 5 by 4 in., stood at 6 ft. 3 in. centres and were notched to receive the five rails of 1½ by 4 in. This was a strong fence, and would be easily repaired.

Major Herbert showed a mortised fence, but the rails should have been stronger and more free of knots. The expense of replacing a broken rail in a mortised fence is considerable.

Owing to its geographical position one could not have expected Cardiff to attract as many exhibitors as one could have wished, unless trade had been very prosperous. Apart from this, the fact that the Royal is being held at Windsor next summer must have been a very strong inducement to landowners to reserve their energies for 1939.

Taken as a whole, however, the show provided much to interest people, and there can have been few visitors to it who did not learn something of value.

G. C. WOLRYCHE-WHITMORE.

Dudmaston, Bridgnorth.

REPORT ON GATE-MAKING COMPETITION, CARDIFF SHOW, 1938.

Only two pairs entered in this competition. The first pair were J. Jones and G. Stinchcombe, employed by Major J. A. Herbert, M.P., Llanover Estate, Abergavenny, Mont. The second were P. Woosencroft and R. Corfield, employed by Lord Davies, Dinam Estate, Llandinam, Mont.

This was a very interesting competition for the public, owing to the fact that the winning pair were an estate carpenter and his apprentice and the second an estate sawyer and a rough carpenter; the two pairs had different methods of working and the public were able to make comparisons. The carpenter and his apprentice won partly because they had better tools but also because they had the extra skill required to make a much neater finish; the other pair, however, made a very good serviceable gate for estate use. The winning pair completed in 1 hour 43 minutes and the second in 2 hours 3 minutes.

The specimen gate was an ordinary five-barred sawn farm gate, having a three-inch top bar, with bevelled shoulder cut into the heel and the two top edges chamfered; there was one brace, mortised into the top bar and with a bevelled shoulder cut into heel; the two uprights were mortised into the top bar; the whole was bolted together, and the tops of the head and heel were rounded and chamfered.

Although the weather was very showery, the many interested spectators stayed in the rain rather than lose their places, and most of them remained from start to finish. It is noticeable that, at a Show, there are always spectators for men actually engaged in a craft. The entry of only two pairs for the three prizes offered was, however, disappointing. Both at Cardiff and at Wolverhampton I was told by gate-makers that they had not known of the competition until it was too late to enter. It might help to get more entries if the Royal Agricultural Society, or perhaps the Royal English Forestry Society, were to appoint one of their members, resident in the district where the Show was to be held, to undertake personally the securing of entries.

On some estates which have the necessary machinery, the material is prepared, as far as possible, with the machines, and the carpenters make the gates at times when they are not too busy with other work; this plan is followed, especially, where the making is in charge of a clerk of works. On other estates the gates are under the charge of the forester, and are usually made by woodmen, fencers or rough carpenters. Such workers can

generally make a very good gate, but can rarely have much chance of winning prizes in competition with carpenters.

The prizes offered at present are: first, £5; second, £3; and third, £2. I suggest that, in future, the competition should be divided into two classes, to be held on different days :—

Class 1.—Qualifications as at present, *i.e.*, including carpenters.

Class 2.—Qualifications as above, but excluding carpenters and joiners.

The prizes in each class might be: first, £3; second, £2; and third, £1.

On many estates the use of machinery has led to the transfer of some of the work, formerly in the hands of the forester, to the estate building department, although the forester is still usually responsible for the erection. If the carpenters make the gates, they should be eligible to compete, and would, by themselves, make a very good class. But I think it will be generally agreed that encouragement should be offered to the woodman and the handyman, and I believe that this would be achieved by giving them a class to themselves. If necessary a simpler type of gate, which would not require so much skill, could be set as the specimen.

F. G. Childs.

Uppington, Wellington, Shropshire.

JUDGES' REPORT ON THE WOODLANDS, PLANTATIONS AND ESTATE NURSERIES COMPETITION, 1938.

THE competition this year was open to estates in North Wales. There were 35 entries from 5 estates, this being slightly below the average for recent years; on the other hand the quality of the plantations entered was high both in the softwood and hardwood classes, and, with the exception of those for coppice and coppice-with-standards, all classes were well filled.

Detailed descriptions of individual entries and estates will be found below under the appropriate class-headings. There are, however, one or two observations which may be introduced at this point.

A notable feature on all the estates visited was the unusually good quality and growth of plantations established at high elevations, Quality Class I Douglas fir being found at elevations exceeding 1,000 ft., and Quality Class I Sitka spruce at elevations exceeding 1,200 ft. Good crops of profitable timber, indeed, were found at considerably higher elevations than the above, and it would appear that the depth and porosity of the soil and subsoil, and absence of pan, are of greater importance in determining the altitude limit of profitable forestry than the actual elevation and exposure. (In many of the mountainous regions of Britain forestry is not a profitable proposition above the 1,000-ft. mark.)

It appears that the marketing of produce does not present so serious a problem in North Wales as is the case in many other parts of the country. On all the estates visited the judges were informed that little difficulty was experienced in the profitable disposal of thinnings.

Special mention must be made of the plantations entered by the Montgomeryshire County Council. Although these plantations did not receive an award they were of high quality. It is in the fact, however, that the County Council have embarked successfully on the afforestation of land that the merit lies. Many County Councils must have land of low agricultural value which might usefully be afforested, and the judges feel that in this respect the Montgomeryshire C.C. have set an example which could be followed with advantage in other parts of the country.

AWARDS IN CLASSES.

CLASS I (*a*). *Young hardwoods.* (10–25 *years.*)

The Silver Medal in this Class was awarded to the Earl of Powis for Dinger's Wood, which also won the Gold Medal for

the best plantation entered in the competition. Dinger's Wood consists of a remarkably fine stand of 17-years-old naturally regenerated ash, situated on clay soil, at 700 ft. above sea level. The previous crop consisted of scanty ash, larch and beech. When these were felled towards the end of the Great War self-sown ash seedlings began to make their appearance. Acting upon this hint the area was fenced in against rabbits, and a very thick growth of seedlings resulted. The total cost of establishment (excluding burning of lop and top) was £3 per acre. The crop has been wisely and continuously thinned since its establishment. In 1925 the trees were thinned out to a distance of approximately 5 ft. apart. They were thinned again in 1932, and again in 1937, there being at the present time approximately 1,000 trees to the acre. It is intended in future to carry out light thinnings in alternate years. The trees now have an average quarter-girth of 3 in. at breast height, a clean bole of 15 ft., and an average height over all of 28 ft. Pruning has been confined to the removal of double leaders, but the stems are exceptionally clean. The individual trees which are likely to comprise the final crop are easily discernible, and special attention is paid to these during thinning operations.

The Bronze Medal was awarded to Park Wood Plantation, the property of Major C. P. Ackers. This 23-years-old plantation is constituted of ash with larch, the intention being gradually to thin out the larch, leaving ash as the final crop. The ash are well grown and of good quality, and should grow into a valuable stand.

CLASS I (*b*). *Hardwoods over* 25 *years.*

The Silver Medal in this class was awarded to Pentrie Mill Plantation, the property of Major C. P. Ackers. This 48-years-old plantation is constituted of ash with an admixture of larch and Douglas fir, most of which will be removed in thinning. The ash are well grown, having an average length of clean bole of 40 ft., some individuals having a clean bole of 70 ft. The crop is inclined to be dense, there being 250–300 stems to the acre, a fact which accounts for the slowing down of growth which has taken place within recent years.

The Bronze Medal was awarded to Lord Penrhyn for Laundry Wood and Bath Wood. This 37-acres wood, nearly a hundred years old, growing at an elevation of 200 ft. on heavy loam over shale, is constituted of oak and beech. Both species show good clean growth, the average quarter-girth at breast height being 16·8 in. for beech and 16·5 in. for oak.

CLASS II (*a*). *Young softwoods.* (10–20 *years.*)

The Silver Medal in this class was awarded to Major C. P. Ackers for Pole Cover Plantation, a 16-years-old stand of Sitka

spruce, growing on a hillside at an elevation of 950–1,100 ft. This plantation is in excellent condition, and has been well tended. It received a light thinning in 1937, and there are at present approximately 1,000 trees per acre. The average height of the trees is 46 ft., and the average quarter-girth at breast height 4·8 in.

The Bronze Medal was awarded to the Earl of Powis for Talyrnan Cross, a 13-year-old plantation of Sitka spruce, having an average height of 30 ft. and an average quarter-girth at breast height of 3·6 in. This promising stand has not yet reached the thinning stage.

Class II (*b*). *Softwoods over* 20 *years.*

The Silver Medal in this class was awarded to Major C. P. Ackers for Roundabout Plantation. This is a very fine 27-years-old stand of Douglas fir, growing on a hillside at an elevation of 750–1,000 ft. above sea level. The plantation has been thinned four times, and the density is now perfect. There are some 400 trees to the acre; the average height of the trees is 69 ft., and the average quarter-girth at breast height $7\frac{1}{2}$ in. The trees were not pruned until 1937.

The Bronze Medal was awarded to the Earl of Powis for Watery Lane Plantation. This plantation was established in 1914 and was constituted of Japanese larch and Douglas fir in alternate lines at 5 ft. apart. It was thinned in 1930, 1934, and 1937, most of the larch having now been removed. There are some 700 trees to the acre, having an average height of 60 ft. and an average quarter-girth at breast height of 7 in.

Class III (*a*). No entries.

Class III (*b*). *Mixed hardwoods and softwoods.*

The Silver Medal was awarded to Major C. P. Ackers for Pentrie Mill Plantation, a 30-years-old stand constituted of ash, Douglas fir, European larch, and Norway spruce. The trees are of good quality and growth, having clean stems of 40 (in some cases 65) ft., and an average quarter-girth at breast height of $8\frac{3}{4}$ in. in the case of ash, and $8\frac{1}{2}$ in. in the case of larch. The rate of growth of the ash has slowed down considerably in recent years, due, perhaps, to insufficient thinning in the earlier stages.

The Bronze Medal was awarded to Lord Penrhyn for Tryngwyn Plantation, a well grown stand of 80-years-old oak, beech, Scots pine and larch.

Class IV. *Any other conifer.*

The Silver Medal was awarded to Major C. P. Ackers for Chimneypiece Plantation, a 12-years-old stand of hybrid larch,

growing at 800 ft. above sea level, planted at 5 ft. apart. The trees are remarkably healthy and clean, averaging 27 ft. in height and 3·2 in. Q.G. at breast height (Japanese larch and European larch in adjoining plots and of similar age measure: Japanese larch, height 23 ft., Q.G. 2·9 in.; European larch, height 19 ft., Q.G. 2·4 in.).

The Bronze Medal was awarded to Major C. P. Ackers for Greenwood, a 19-years-old stand of Abies Grandis, planted at 5 ft. apart. This plantation was thinned in 1930, and again in 1938. The trees average 43 ft. in height and 5½ in. Q.G. at breast height. There has been some wind damage, both in the form of wind blow and in curvature of the stems, but the crop as a whole is clean and well formed.

There were no other entries in this class.

Class V. *Coppice, and coppice-with-standards.* No entries.

Class VI. *Estate nurseries.*

Both of the winning entries in this class were of exceptional merit, and it is probable that either of them would bear favourable comparison with any other estate nursery in the country. It was unfortunate, therefore, that there were so few entries.

The Silver Medal was awarded to Lord Penrhyn for his admirable nursery, 4 acres in extent. The judges could find no single point for adverse criticism. The whole nursery, indeed, was in perfect condition; the soil was clean and well cropped; the general layout and arrangement of shelter belts was ideal; the seedlings and transplants were well tended and of first-rate quality. Besides forest trees a quantity of ornamental trees and shrubs were grown, and these find a ready market in the neighbouring town of Bangor. An examination of the accounts showed that the nursery is run on sound economic lines, and that it should prove a source of steady and increasing profit.

The Bronze Medal was awarded to the Earl of Powis for his 2¼-acre nursery. This nursery too was in excellent condition, fully stocked with well-grown seedlings and transplants. It supplies all the estate woodland requirements, is economically managed, and is exceptionally well cared for.

Class VII. *The best managed estate woodlands.*

The entries in this class were, as always, of the greatest interest. It is probable, indeed, that an even greater value attaches to the awards in this class than to those in any other, for in this class the economical and business management of the woodlands as a whole is of prime importance, and the judges must take into account, besides that good silviculture which wins prizes in other classes, every branch of good management

including nursery work, profit and loss, amenity and sporting value and general care.

The Silver-Gilt Medal was awarded to the Earl of Powis for the Powis Castle estate woodlands. These woodlands are some 1,500 acres in extent. They have been under systematic management for thirty-eight years, but disproportionately heavy fellings were necessarily made during the Great War, with consequent serious interference with their normal development. Approximately 300 acres, however, were replanted between the years 1919 and 1936, and the woodlands are now being worked in their correct normal rotation, all arrears having been made good.

The exceptional post-war replantings consisted largely of softwoods, but the land is eminently suited to hardwoods, and it is intended that the woodlands shall ultimately consist for the most part of oak, ash and beech, the existing softwood plantations being regarded as a short-rotation catch-crop.

Of the 1,500 acres of woodland 500 acres are composed of plantations less than 40 years of age, the remainder being mature, and consisting largely of oak. For the past thirty-eight years the woodlands have been managed on very sound and careful business lines. Throughout that period they have been a definite asset, and there can be no question but that their productive capacity is steadily increasing.

Powis Castle is famous alike for the beauty of its parks and woods and for its magnificent covert-shooting. Rightly regarded as one of the most beautiful estates in the country, it is in the highest degree commendable that the woodlands are, silviculturally speaking, in such excellent condition, and that they are managed on such an economic and productive basis. Powis Castle, indeed, in its successful combination of commercial forestry, amenity, and sport, is a perfect example of the manner in which woodlands on private estates should be developed.

The Silver Medal was awarded to Lord Penrhyn for the Penrhyn Castle estate woodlands. These have been systematically managed for the last eight years and, though much remains to be done, a great deal has been accomplished in that time. At the commencement of that period the woodlands, 3,000 acres in extent, consisted largely of scanty stands of mature hardwoods, but there was also a considerable acreage of young and middle-aged plantations in need of thinning. It was rightly considered that this last-named operation was of the first urgency, and thinning has been systematically and intensively carried out. As a result the plantations are now in good order, and show promise of growing into fine stands of profitable timber. Besides this 160 acres have been planted during the last eight

years, some of it on new ground, so that a skeleton series of age-classes has now been formed.

One can say, therefore, that the preparatory work has been successfully completed, and that the woods have been put on a sound basis for increasing future productivity. The silvicultural condition of the woods has been radically improved, and this has been effected with the greatest possible economy. The marketing side has been extensively developed; the sawmill and conversion plant has been enlarged and modernized; thinnings and mature timber are being marketed profitably; the nursery is already a profitable source of income; and it may be anticipated that the woodlands will become an increasingly valuable asset as the results of the present wise management come more fully into effect.

The Bronze Medal was awarded to Sir Edward Naylor-Leyland, Bart., for the woodlands at Nantclwd, Ruthin. Whereas at Powis Castle the woodlands have been under systematic management for thirty-eight years, and those at Penrhyn for eight years, it is only now that the Nantclwd woodlands are coming under intensive management. This is not to say that they have been neglected in the past; on the contrary, a considerable area of young plantations has been established in the course of the last twenty-five years, their primary purpose, however, being the formation of game covert. The greater part is ripe for thinning, and this is now in process of being carried out. Over much of the area there is evidence that regeneration of ash by natural means would be a practicable proposition, and it is proposed to attempt this in favourable situations. The judges would add a word of commendation for the young forester who is in charge of the woods, and who is displaying a real knowledge of the problems which confront him. He has already effected a great improvement in the condition of the woods, and his programme for the future is a wise and practical one.

N. A. ORDE-POWLETT.
T. RUSSELL MACDONALD.

REPORT OF THE COUNCIL TO THE ANNUAL GENERAL MEETING OF GOVERNORS AND MEMBERS OF THE SOCIETY

HELD AT

16, BEDFORD SQUARE, LONDON, W.C.,

On WEDNESDAY, December 7th, 1938, *at* 12 *noon.*

Society's Centenary.

1. As announced in the last annual report, the Society will next year celebrate its Centenary. By permission of His Majesty The King, the annual Show will be held on the Cavalry Exercise Ground in Windsor Great Park, where the Show took place on the occasion of the Society's Jubilee in 1889. His Majesty has expressed a desire to do everything possible for the success of the Windsor Show, and to be kept informed of the progress of the arrangements.

H.M. The King to be President.

2. Further, His Majesty has graciously consented to be President of the Society during its Centenary year, and has invited the Earl of Athlone to act as Deputy-President, which office his lordship has signified his willingness to accept.

Royal Portrait.

3. Governors and Members will learn with the greatest gratification that His Majesty has also graciously consented to have his portrait painted by Mr. Oswald Birley, R.O.I. This, on completion, will be hung in the Council Room at 16, Bedford Square.

History of the Society.

4. Professor Scott Watson, the Editor of the Society's *Journal*, is now engaged on the task of compiling the History of the Society since its formation, and it is hoped that a coloured print of His Majesty's portrait, referred to in the previous paragraph, may be included in the volume to be published in the week of the Smithfield Show in 1939.

Prize List for Windsor Show.

5. The List of Prizes to be offered at the Windsor Show will be issued in the New Year. In celebration of the Centenary of the Society, the Council have voted £12,500 towards the Prizes and a Commemoration Medal will be awarded to First Prize

winners in each inspection class of horses, cattle, goats, sheep and pigs, but no Exhibitor may take more than one of these medals in any section in which he exhibits.

6. In addition, offers of Champions, Challenge Cups and Class Prizes have been received from the following Breed Societies :—Shire Horse Society, Clydesdale Horse Society, Suffolk Horse Society, British Percheron Horse Society, Hunters' Improvement and National Light Horse Breeding Society, National Pony Society, Arab Horse Society, Welsh Pony and Cob Society, Shetland Pony Stud Book Society, Shorthorn Society, Hereford Herd Book Society, Argentine Hereford Breeders' Association, Devon Cattle Breeders' Society, Sussex Herd Book Society, Sussex Cattle Breeders' Society of South Africa, Welsh Black Cattle Society, Longhorn Cattle Society, Aberdeen-Angus Cattle Society, English Aberdeen-Angus Cattle Association, Dun and Belted Galloway Cattle Breeders' Association, Galloway Cattle Society, Lincolnshire Red Shorthorn Association, South Devon Herd Book Society, Red Poll Cattle Society, Blue Albion Cattle Society, British Friesian Cattle Society, Ayrshire Cattle Herd Book Society, English Guernsey Cattle Society, English Jersey Cattle Society, British Kerry Cattle Society, Dexter Cattle Society, British Goat Society, Oxford Down Sheep Breeders' Association, Shropshire Sheep Breeders' Association, Southdown Sheep Society, Hampshire Down Sheep Breeders' Association, Suffolk Sheep Society, Dorset Down Sheep Breeders' Association, Dorset Horn Sheep Breeders' Association, Wiltshire Horn Sheep Society, Ryeland Flock Book Society, Kerry Hill (Wales) Flock Book Society, Clun Forest Sheep Breeders' Association, Lincoln Longwool Sheep Breeders' Association, Leicester Sheep Breeders' Association, Society of Border Leicester Sheep Breeders, Wensleydale Longwool Sheep Breeder's Association, Kent or Romney Marsh Sheep Breeders' Association, Welsh Mountain Sheep Flock Book Society, Black Welsh Mountain Sheep Breeders' Association, National Pig Breeders' Association, Large Black Pig Society, Essex Pig Society, Gloucestershire Old Spots Pig Society, Cumberland Pig Breeders' Association, National Long White Lop-eared Pig Society, National Welsh Pig Society.

7. Special Prizes are being offered in the Poultry section by the Croad Langshan Club, Sussex Poultry Club, Buff Orpington Club, Rhode Island Red Club, Plymouth Rock Society, Buff Plymouth Rock Club, Australorp Club, Indian Game Club, Silkie Club.

Closing of Entries.

8. Intending exhibitors at Windsor are reminded that the final date for receiving entries of Live Stock is MAY 1st. Entries

for Poultry, Eggs, Produce and Butter-making Competitions close on MAY 20th.

9. Applications for space in the Implement, etc., Department must be made not later than March 20th.

Membership.

10. Since the last annual meeting on the 8th December, 1937, the list of Governors and Members has undergone the following changes: 28 new Governors (including 5 transferred from the list of Members under Bye-law 9) and 594 new Members have joined the Society, and 1 Life Governor and 4 Life Members have been reinstated under Bye-law 14; whilst the deaths of 8 Life Governors, 6 Governors, 65 Life Members, 172 Members and 1 Honorary Member have ben reported. 2 Life Governors, 12 Life Members and 9 Members have been struck off the books under Bye-law 12, owing to absence of addresses; 1 Governor and 85 Members under Bye-law 13, for arrears of subscription; 3 Governors and 203 Annual Members have resigned.

11. During the past twelve months the Council have suffered the loss of seven of their number, including the Duke of Devonshire, Lord Harlech and Lord Daresbury.

12. The Duke of Devonshire first became associated with the Society in 1892. Six years later he joined the Council, becoming successively a Vice-President and a Trustee. His Grace twice occupied the Presidential chair—in 1908, when the Show was at Newcastle, and in 1933, when the show took place at Derby. It may be recalled that three years ago, in the course of a speech at the annual meeting, the late Duke said: "I have not written and I do not propose to write my reminiscences, but I can assure you that if I did my connection with the Royal Agricultural Society of England would occupy a very high and honoured place." His Grace had an affection for the Society, and always took the greatest interest in its work.

13. Lord Harlech joined the Society fifty years ago, and was elected to the Council in 1910 for his home county of Shropshire. In 1923 he became a Vice-President, and six years later a Trustee. He was President in 1928 when the Show went to Nottingham.

14. Mr. F. H. Thornton, who died last December, had been a member since 1906, and had represented Northamptonshire on the Council for seventeen years, during which period he served on the Veterinary and Research Committees.

15. The Right Hon. M. M. McCausland had been associated with the Society for 31 years, but it was only in 1936 that he became a member of the Council to represent the division of Ireland.

16. Mr. C. H. Sample was elected a member in 1891, and since 1923 had served on the Council as one of the representatives of the division of Northumberland. Mr. Sample rendered great service to the Society in connection with the Shows held at Newcastle in 1923 and 1935.

17. Mr. Eustace Abel Smith's connection with the Society began in 1889, when he became a member: he joined the Council in 1930 as one of the representatives of Lincolnshire. The Chairman of the Finance Committee and all its members valued very highly the expert advice and wise counsel which they received from Mr. Abel Smith, more especially in connection with the Society's investments and their recent re-organization.

18. Lord Daresbury had been associated with "the Royal" for 46 years; he joined the Council in 1904 and was elected in turn a Vice-President and a Trustee. He will long be remembered by Governors and Members for the invaluable services he rendered to the Society over a quarter of a century as Honorary Director of the Show, taking up his duties at a time when the resources of the Society had been sadly depleted by the unsuccessful Park Royal venture. On his retirement from that office in 1930 he was presented at the Annual General Meeting with a service of Gold Plate.

In 1910, when the Show was at Liverpool, and again in 1925, when the Show was at Chester, he occupied the Presidential Chair; coupling his duties as Honorary Director with those of President on both occasions.

It is not too much to say that Lord Daresbury was one of the most prominent agriculturists of our time, and the Royal Agricultural Society in common with many kindred organizations has suffered a grievous loss.

19. The death has also to be recorded of Mr. William Bainbridge, who will be remembered by many Governors and Members as Agent for Lord Daresbury. At the Harrogate Show Mr. Bainbridge was elected an Honorary Governor of the Society in recognition of his valued services during the long period that Lord Daresbury was Honorary Director of the Society's Show.

20. Amongst other Governors and Members whose loss by death the Society has to deplore are Prince Arthur of Connaught, K.G., the Marquis of Abergavenny, Frances Countess of Warwick, Lord Leigh, Lord Roborough, Lord Stanley, M.C., M.P., Capt. the Right Hon. R. C. Bourne, M.P., Sir Robert L. Mond, LL.D., Mr. Edmund Beck, Mr. Walter Briggs, Mr. J. E. Compton Bracebridge, Mr. T. A. Crombie, Mr. John Garton, Mr. John B. Gill, Lieut.-Col. W. E. Harrison, O.B.E., Mr. Paul Hoffmann,

Mr. W. R. Hustler, Mr. J. B. Manuel, M.R.C.V.S., Mr. A. E. Marsh, Mrs. G. H. Morrell, Capt. R. J. E. Oliver-Bellasis, Mr. Wilfrid H. Parker and Mr. T. L. Price.

Numbers on Register.

21. These and other changes bring the total number of Governors and Members on the Register to 8,882, divided as follows :—

133 Life Governors;
207 Annual Governors;
1,547 Life Members;
6,977 Annual Members;
18 Honorary Members.

8,882 Total number of Governors and Members, as against a total of 8,823 on the Register at the time of the last Annual Report.

22. It may be of interest here to record that in the 12 months ending 31st July, 1889 (the Society's Jubilee year), the total number of new Members elected was 2,752.

Increased Privileges for Members.

23. Much attention has been given by the Council in the past year to the question of increasing the privileges to be enjoyed by Members of the Society. At the Annual Show a portion of the Grand Stand at the Large Ring is now set aside for the exclusive use of Members, and considerable improvements have been introduced in the special Pavilion provided for the use of Members in the showground.

24. In addition, the privileges in connection with the Chemical, Botanical, Zoological and Veterinary Departments of the Society, for which hitherto certain fees were payable, may now be made use of by Members *without any further payment* beyond the annual subscription.

25. Since these new arrangements came into operation, the numbers joining the Society have shown some increase, but the Council are looking forward to a large influx of new subscribers during the ensuing twelve months as a memorial to the attainment by the Society of 100 years of corporate existence.

26. *It is earnestly hoped, therefore, that every individual Governor and Member will do all in his power to support the Council in their campaign, and by introducing at least one new subscriber.* A Nomination Form for this purpose is attached to this Report, but the Secretary will be happy to forward additional forms on request.

Changes in the Council.

27. Mr. R. K. Wright has been elected to fill a vacancy on the Council in the representation of Ireland, and Mr. N. V. Stopford Sackville has been elected as the representative of Northamptonshire. The Earl of Powis, Lord Desborough and Mr. R. M. Greaves have been appointed Trustees, and the vacancies thus created in the list of Vice-Presidents have been filled by the election of the Earl of Plymouth, Mr. Fred Smith and Mr. Joseph Harris.

Dates of Council Meetings.

28. The following dates have been fixed by the Council for their meetings in 1939: February 1st, March 1st, April 5th, May 3rd, June 7th, July 5th in the Windsor Showyard, July 26th, November 1st and December 6th.

Elections to the Council

29. Members of Council retiring under the scheme of rotation at the forthcoming Annual Meeting are those representing the electoral districts of Group A, comprising Bedfordshire, Cheshire, Cornwall, Derbyshire, Dorset, Hampshire and Channel Islands, Hertfordshire, Lancashire and Isle of Man, Middlesex, Monmouthshire, Norfolk, Northamptonshire, Northumberland, Staffordshire, Worcestershire, Yorkshire (North Riding) and Scotland. Elections are also being held in the Divisions of Lincolnshire and Suffolk to fill vacancies which have occurred. Governors and Members registered in those districts have been communicated with, and the usual procedure is being followed for the election or re-election of representatives for the Divisions concerned.

Investments.

30. Investments have, during the year, been the subject of consideration by the Society's Finance Committee, who came to the conclusion that the Society held too great an amount of its capital in $3\frac{1}{2}$ per cent. Conversion Stock, which is not terminable except at the option of the Government. On the Committee's recommendation, therefore, half of the holding has been sold and the proceeds re-invested in the following securities with fixed redemption dates: 3 per cent. Funding Loan 1959–1969, 3 per cent. Conversion Stock 1948–1953, and 3 per cent. Redemption Stock 1986–1996. These transactions have entailed an annual loss of income of about £260, but against this, security has been gained on the capital side.

31. The Hills' Bequest Fund holding of $3\frac{1}{2}$ per cent. Conversion Stock has also been sold, and re-invested in 3 per cent. Redemption Stock 1986–1996.

Charrington Bequest.

32. Notification was received early in the year of the Society being a residuary legatee in respect of one-thirtieth part of the residuary estate of the late Mowbray Vernon Charrington. A sum of £761 7*s*. 11*d*. has been received on account of part of this legacy, and, in addition, the trustees of the estate have allotted to the Society certain Preference and Ordinary shares of Charrington and Company, Ltd.

Accounts.

33. In compliance with the bye-laws, the Council beg formally to submit the balance-sheet with receipts and payments for the year 1937. These accounts were circulated to Governors and Members in June last, having been certified as correct by the Professional Accountants and Auditors. Copies of these accounts and also the Statement of Receipts and Expenditure of the Show held this year at Cardiff, will be available for reference at the meeting on December 7th.

Donations.

34. Towards the Building Fund being raised by the National Institute for Research in Dairying, the Council have made a donation of £100.

35. They have also agreed to subscribe a total sum of £1,000 towards the Fund which has recently been launched by the Rothamsted Experimental Station to celebrate the forthcoming Centenary of that Institution.

Staff Superannuation.

36. A new scheme has received the assent of the Council providing for the superannuation of the members of the Society's Staff at 16, Bedford Square, at the age of 65. The existing scheme of 1911 will be wound up and arrangements made by Policies of Insurance and the General Funds of the Society to secure for present and future members of the staff a Pension equal to half their salary on retirement.

Cardiff Show.

37. Under the Presidency of the Earl of Plymouth the 97th Annual Exhibition of the Society was held in Cardiff on practically the same conveniently-situated ground, adjoining Sophia Gardens, as that occupied by the previous Shows in 1901 and 1919. Machinery, implements and other industrial exhibits provided a representative display, although the number of stands in this department was 67 fewer than at Wolverhampton. The livestock entries, too, with the exception of the sheep and goat classes, showed some reduction, but quality was not lacking. As a whole, the Welsh breeds with their extended

classification were well supported. A feature of much interest this year was the exhibit of colliery horses from all parts of the Monmouthshire and South Wales coalfield. Despite adverse climatic conditions earlier in the year, the Flower Show once again maintained its reputation as one of the principal attractions of the Exhibition.

38. H.R.H. The Duke of Kent, who travelled to Cardiff by air, favoured the Show with a visit on the Wednesday. His Royal Highness spent four and a half hours on the ground, and was greatly interested in the exhibits, the Display of Colliery Horses, and the events in the Large Ring, which he watched from the Royal Box in the Grand Stand.

39. The Show opened on Tuesday, July 5th, in somewhat showery weather, but for the most part judging of stock was carried through without interference and according to programme. Wednesday had sunshine for most of the day, but that night there was exceedingly heavy rain, and throughout Thursday showers came at intervals. There was some improvement on the Friday, and, though the morning of Saturday was none too promising, the sun shone in the afternoon, and the closing day had the biggest attendance of the week. The turnstiles registered a total attendance of 80,378 for the 1938 Show, compared with 191,694 on the occasion of the Society's previous visit to Cardiff in 1919.

40. At the General Meeting on the Tuesday the thanks of Governors and Members were conveyed to the Lord Mayor and Corporation of Cardiff; to Mr. Hubert Alexander, the Hon. Treasurer; and to the Local Committee for their cordial reception of the Society and all they had done to promote the success of the Show. The Society is also greatly indebted to the Marquis of Bute for placing such an excellent showground at the disposal of the Society.

New Implements.

41. Three Silver Medals were awarded by the Judges of New Implements at the Cardiff Show—to Cooch & Sons, Northampton, for a Potato Sorting Table, with Roller Conveyor; to John H. Darby, Rugby, for a Thatching Needle; and to Bamfords, Ltd., Uttoxeter, for an Artificial Manure Distributor. The tests of two entries have not been completed, and they will be eligible for re-entry next year.

Young Farmers in Judging Contests.

42. England, Wales, Scotland and Northern Ireland were represented by teams in this year's competition on the Wednesday, which was keenly contested. A difference of only

two marks separated the winners, Northern Ireland, from England, the runners-up. Wales took third place and Scotland fourth.

Exhibits by Young Farmers.

43. Young farmers from all parts of Wales brought their stock for exhibition in the showground on the Thursday. Notwithstanding the rain during the morning, there was a good entry in the eight classes, and the cattle, of both beef and dairy breeds, made a highly creditable display. In the afternoon the President, the Earl of Plymouth, accompanied by Lady Plymouth and Mr. Morrison, Minister of Agriculture, presented the awards to the successful competitors who assembled in front of the Royal Pavilion. After short addresses by Lord Plymouth, Mr. Morrison and Sir Merrik Burrell, the Young Farmers paraded their stock in the Ring, preceded by the members of the International teams carrying their banners.

Woodlands, Plantations and Estate Nurseries.

44. In this year's competition, which was restricted to North Wales, there were 35 entries. The Earl of Powis was awarded the Royal English Forestry Society's Gold Medal for the best plantation, as well as the Special Silver Gilt Medal of the Royal Agricultural Society of England for the best-managed Woodlands on an estate of not less than 1,000 acres.

45. Next year the area of the Woodlands, etc., Competition will include the counties of Berkshire, Buckingham, Oxford, Hertford, Bedford and Middlesex.

Oak Wood Competition.

46. In connection with its Centenary, the Society is offering a Trophy of the value of Twenty-five Guineas for the best Oak Wood in the whole of England and Wales eligible under the following conditions:—

1. The Wood or such part of a Wood as is entered must be not less than 10 acres in extent.
2. The average number of Oak Trees per acre entered must be not less than 20, each of which must be not less than 100 years of age.
3. Coppice Woods and Mixed Woods are eligible.

Entries close on the 30th November, 1938.

47. The Council also have under consideration the organization of a further Competition for the best Single Oak Tree in the country, with the particular object of obtaining a modern record of the finest oaks in existence.

Future Shows.

48. As mentioned in the last report of the Council, the Royal Show of 1940 will be held on the Carholme at Lincoln.

49. Possible sites for later Shows, in Devonshire and in Yorkshire, are under consideration.

Argentine Show Judges.

50. Once again the Argentine Rural Society sought the assistance of the Council in the selection of Judges to officiate at the Palermo Show. The following gentlemen accepted the invitation of the Society :—

Aberdeen Angus Cattle.—Mr. W. G. Macpherson, Mulben Mains, Banffshire.

Hereford Cattle.—Mr. Stafford Weston, The Bounds, Much Marcle, Ledbury.

Berkshire Pigs.—Mr. Frank Townend, Highfield, Moor Allerton, Leeds.

On this occasion the services of a Judge of Shorthorns from this country were not required by the Argentine Society.

Tractor Tests.

51. In September, 1937, a Tractor Testing Scheme was inaugurated by the Society, which was fully explained in an article by the Consulting Engineer (Mr. S. J. Wright) in Volume 98 of the *Journal.* The tests of six of the seven machines left over from 1937 were carried out in the month of March. A further ten Tractors were entered this year, and these were duly tested in September. Reports on this year's tests are now available, and may be obtained from the Director, Research Institute in Agricultural Engineering, Oxford.

Long Service Awards.

52. Medals and Certificates for Long Service have been awarded to the following farm servants since the last report was made :—

Years' Service.	
67.	Richard Carter, Back Lane, Herriard, Basingstoke.
66.	Henry Vare, Chestnut Cottages, East Wellow.
64.	Edwin Woolgar, West Lodge, Shipley, Horsham.
61.	Walter Branch, Station Road, Waterbeach, Cambs.
55.	Jesse Taylor, Nelson Cottages, Griston, Watton, Norfolk.
54.	Frederick Greenough, Ardington, Wantage.
54.	Daniel Neal, Decoy Farm, Sedge Fen, Lakenheath, Suffolk.
54.	James Albert Peacock, Maplescombe, Romsey, Farningham, Kent.
53.	William Henry Gilford, 5, Cheswell, Lilleshall, Wellington, Shropshire.

Years' Service.	
53.	George Moyes, Woolverstone, Ipswich.
53.	William Webb, 8, Helshaw Cottage, Stoke Heath, Market Drayton.
51.	Harry Card, Handley, Salisbury.
51.	Samuel James Mills, High Street, Haslingfield, Cambs.
51.	George Lewington, Aston Tirrold, Didcot, Berks.
51.	George Mottram, Lyme Park Farm, Disley, Stockport.
51.	James Tomkins, Wigston Parva, Hinckley.
50.	Charles Barrett, Tredegar Park, Newport, Mon.
50.	William Thomas Birt, The Lodge, Thorpe, Staffs.
50.	Francis Newall, Newnham Bridge, Tenbury Wells, Worcs.
50.	Frank Pritchard, Westbeach, Pattingham, Wolverhampton.
50.	William Skinner, The Court Lodge Cottages, Horton Kirby, Kent.
50.	James Whiting, Floodgates, West Grinstead, Horsham.
49½.	Henry Tuckwell, Upper Culham, Park Place, Henley-on-Thames.
48.	John Bishop, 1, Council Houses, High Street, Haslingfield, Cambs.
47.	William Thomas Blake, Chalk Hill, Aston Tirrold, Didcot, Berks.
47.	Arthur S. Chapman, Watton Road, Griston, Watton, Norfolk.
46.	Ezra Elkerton, New Town, Haslingfield, Cambs.
46.	George Smith, The Gardens, Hound House, Shere, Guildford.
45.	George Dudman, 4, Hodson, Wroughton, Swindon.
44.	John Chapman, Griston, Watton, Norfolk.
44.	Albert Jones, Aston Tirrold, Didcot, Berks.
44.	William Knight, Pound Cottages, Shipley, Horsham.
44.	Frank Peacock, The Court Lodge Cottages, Horton Kirby, Kent.
43.	Leonard Barnard, Moss Lane, Haslingfield, Cambs.
42.	David Pope, Aston Tirrold, Didcot, Berks.
41.	George Coxall, Sand Lane, Alfreth, Ely, Cambs.
40½.	Fred Warren, Moor Farm, Cowdray Park, Midhurst, Sussex.
40.	Martin Pagram, Denny Gate Cottages, Waterbeach, Cambs.
40.	William George Tuckwell, Pillar Lodge, Park Place, Henley-on-Thames.
40.	Albert Walker, Radway Green Road, Barthomley, Crewe.

53. Under the Society's scheme, Service qualifying for a Medal is forty years on the same or different holdings with one employer, or forty years on the same holding with different employers. Farm workers (male or female) — excluding gardeners, grooms and gamekeepers—in any part of England or Wales are eligible for the awards.

54. Claims on behalf of farm workers must be made through County Agricultural Societies on special forms which may be obtained from the Secretary of the Royal Agricultural Society of England, at 16, Bedford Square, London, W.C.1.

Chemical Department.

55. On January 1st, 1938, a scheme was put in operation whereby Members of the Society were enabled to have samples tested free of charge in the Society's Laboratory, provided that the analysis made was for the sole use of the Member who, at the same time, was not commercially engaged in the manufacture

or sale of the particular article submitted. The number of samples submitted during the past year is about the same as for the previous twelve months, namely, 121, against 100 in 1937.

56. The outstanding feature to record is the increased number of samples of water submitted, the number amounting to one-third of the total samples sent. This may be due in some measure to the recent water scare, and also to the desirability of having additional water supply in case of emergency, national and otherwise.

57. Members of the Society have received during the year the leaflet on Lime, giving guidance as to the purchase and subsequent use upon the land.

58. There has been an increase in the number of samples of lime submitted in consequence of the Government's policy in facilitating the purchase of Lime and Basic Slag. It has been noticed that whilst the price of lime has remained steady, the quality has, in many cases, sadly deteriorated. Members would be well advised to buy only on analysis made in the Society's Laboratory.

59. Other matters of interest include the analysis of a sample of Town Refuse, comparative analysis of White Oats and Huskless Oats, and investigation into the cause of death of several thousand fish in an ornamental lake.

Consulting Chemist.

60. The Council have appointed Mr. Eric Voelcker, A.R.C.S., F.I.C., as Consulting Chemist to the Society in succession to his uncle, the late Dr. J. A. Voelcker.

Botanical Department.

61. The abnormal climatic conditions of 1938 had a noticeable effect on the kind of enquiries received in the Botanical Department. The severe drought and the frosts in the late spring naturally resulted in a number of specific enquiries. But they appear at the same time to have been responsible for a slightly smaller number of the type experience has led one to expect at different periods of the year.

62. Weed identifications formed a larger percentage of the total than usual, and it was noteworthy that the majority of the specimens came from indifferent pasture land. Next in order of frequency came requests for information about actual or suspected fungoid diseases of crops. The cereals provided most of these, although, on the whole, they appeared to be more free from diseases than usual.

63. There was an increased demand for information on the characteristics of newly-introduced varieties of cereals, and some members followed up their enquiries, made in the previous year, by sending in useful reports on varieties they had tried for the first time. Soya beans were again the subject of some correspondence, which was of interest, as it gave the results of attempting to grow the crop in various parts of the country.

Zoological Department.

64. The work of the Department chiefly consists in advising Members in cases of trouble to crops or farm animals due to animal agency. The enquiries during the year have been less numerous than is desired, but their scope has been very wide.

65. Insect pests of crops were the most frequent subjects of enquiry, but they presented few points of interest, all being concerned with well-known insects, though in some cases it was possible to indicate improved methods of dealing with them.

66. Arachnids and worms also cause injury to farm crops and animals, and several questions concerning them were dealt with. Occasional enquiries were received concerning forest pests, but more numerous were those dealing with injury to dead timber, while several insects infesting stored foodstuffs were sent for identification and advice as to treatment.

67. Each year is characterised by the predominance of certain pests and the comparative absence of others. During the past season cut-worms, asparagus beetle and every kind of aphis appeared in great abundance. Bean aphis was especially prevalent, and for the first time was reported as distinctly injurious to sugar beet. Celery-fly, so destructive last year, was this season almost absent in most districts.

Consulting Veterinary Surgeon.

68. At the beginning of the year the Council appointed the Principal of the Royal Veterinary College, Professor J. Basil Buxton, M.A., F.R.C.V.S., as Hon. Consulting Veterinary Surgeon to the Society in place of the late Principal, Sir Frederick Hobday, now retired.

Veterinary Department.

69. A number of Members of the Society have been in consultation with the clinical department of the Royal Veterinary College and advice has been given on a variety of subjects, including the following: Periodic Ophthalmia; Worm infection; the use of X-rays and their applicability to conditions of the hip and elsewhere; swine erysipelas; pneumonia in young stock, telegony and Johne's disease.

70. Work carried out by the Division of Preventive Medicine for members consisted mainly of advice, and the examination of milk and blood samples in regard to bovine mastitis and abortion. Many enquiries have also been made concerning sterility and a member of the Division has this year spent some time with sterility experts abroad in order to help in dealing with enquiries of this nature.

71. The chronic contagious form of mastitis continues to be the most common form of the disease, although other kinds of mastitis, not susceptible to the same control measures, have not been uncommon. The experiments on the treatment of the chronic form of mastitis by udder injection, to which reference was made in a previous report, have led to the conclusion that some 60–80 per cent. of latent or early cases can be cured, but that treatment of advanced cases is only satisfactory in a small percentage. Experimental treatment of this form of mastitis by oral administration of some recently discovered chemical agents, which have been found active in other streptococcus infections, is proceeding.

72. Reference was made in last year's report to the work of the Research Institute on diseases of young calves, work which is financed in part by the Society. In a preliminary survey on the causes of death in a random sample of 100 calves, it was found that, while "white scours" held first place, pneumonia was also an important cause of morbidity and death. The bacteria associated with these cases of pneumonia have now been examined more intensively and in particular the organism known as *Corynebacterium pyogenes*, which belongs to the same bacteriological group as that which is responsible for diphtheria in man. One of the problems facing the bacteriologist is the manner by which bacteria produce their effects on animals. In the case of *C. pyogenes*, this has hitherto been somewhat of a mystery, but now, by special technique, it has been possible to show that the organism excretes a toxin, just in the same way as the tetanus bacillus, for example, is known to do. This finding is likely to have practical importance in vaccinating or protecting stock from the effects of the organism and the point is now being subjected to further investigation.

73. A piece of research somewhat similar in nature has also been engaging the attention of the Institute. Mastitis in sheep is often due to a particularly variety of *Staphylococcus* and this organism also is known to produce a toxin. By chemical treatment, it is possible to alter this toxin so that, while it loses its poisonous properties, it retains its power of stimulating resistance. By inoculating sheep with this altered toxin—or

toxoid, as the product is called—it has been found that they can be in large measure protected from the effects of the staphylococcus when cultures of this germ are injected up the teat canal of the ewe's udder. Further work on this subject is proceeding.

74. Other problems at present being studied include cirrhosis of the liver in pigs. This disease is shown by a hardening of the liver tissue, so rendering the organ less useful to the animal and valueless as an article of human food. The wastage in abattoirs from this cause is considerable. The condition is quite possibly connected in some way with the diet and attempts are being made to throw some light on the subject.

75. Numerous requests for advice have been dealt with by the Department of Animal Husbandry during the past year, especially concerning the suitability of various feeding stuffs.

76. Several cases have occurred recently in which municipal authorities have installed water softening systems. Animal owners, bearing in mind that a medium hard water containing about 15 to 20 degrees of total hardness, is generally regarded as being best for farm stock, have consulted the College regarding the possible effects of using softened waters for their stock. The amount of calcium and magnesium in even hard waters (25 to 30 degrees) is only a fraction of the intakes required for normal physiological function of the animal body. It is evident, therefore, that, provided the water is otherwise safe, the lime content does not greatly matter as a source of minerals. The greatest intake of the essential minerals always comes from the food. Should there be a doubt, it is much safer to reinforce mineral intakes by adding to the rations a supplementary supply of minerals, in the form of a good quality bone meal or bone flour, or perhaps in the form of a mineral mixture, made as complete as our present knowledge will allow.

77. An investigation is in progress regarding the effects of using cod-liver oils of good, medium and poor quality for pigs. Reference has already been made in these reports to the desirability of using only oils carrying a guarantee of vitamin potency. The use of the word "veterinary" to describe a brand of cod-liver oil is, unfortunately, no guarantee that the oil in question is a reliable product. There are still brands upon the market which are sold as "veterinary cod-liver oils," which are not only unsuitable, but may be actually dangerous for pig or poultry feeding. Work on this is still in progress, but it is too early to form any definite conclusions.

78. Enquiries have been dealt with concerning the diagnosis of pregnancy in mares. It is hoped to publish the results

obtained by a comparison of three different methods at a later date. In the meantime it may be pointed out that no one method, of those used at present, will give 100 per cent. accurate results.

Animal Diseases.

79. It will be seen, from the comparative figures below, for the confirmed outbreaks of the scheduled diseases during the first nine months of the year that, with the exception of those in connection with Anthrax and Foot-and-Mouth Disease, the position is much more favourable than in 1937, decreases being shown in the case of Parasitic Mange, Sheep Scab and Swine Fever :—

	Anthrax.		Foot-and-Mouth Disease.		Parasitic Mange.		Sheep Scab.	Swine Fever.
	Outbreaks.	Animals Attacked.	Outbreaks.	Animals Slaughtered.	Outbreaks.	Animals Attacked.		
1938—January 1st to October 15th	647	1,013	163	20,699	44	74	126	584
1937—Same period	553	662	22	5,097	100	138	147	834

The number of animals attacked in the case of Anthrax is exceptionally high, but this is solely due to the fact that in an outbreak which occurred in East Sussex during August, 292 other animals than bovines were attacked. Not only do the figures in connection with Parasitic Mange, Sheep Scab and Swine Fever compare favourably with those for the first nine months of 1937, but also with those for the same period of 1936 and 1935. In the latter year there were 87 outbreaks of Parasitic Mange, 278 of Sheep Scab and no less than 1,591 of Swine Fever.

Quarantine Station and New Zealand Embargo.

80. Further steps have been taken in an endeavour to remove the unfortunate misapprehension which appears to prevail in New Zealand as to the danger of admitting British livestock to that Dominion through the London Quarantine Station. It has been stated by the Ministry of Agriculture, on the authority of their Chief Veterinary Officer, that during the 10 years the Station has been in existence there have been no cases in the Station of diseases required to be certified under the Order of 1928, viz., Cattle Plague, Foot-and-Mouth and Pleuro-Pneumonia.

Queen Victoria Gifts.

81. For the present year the Trustees of the Queen Victoria Gifts Fund made a grant of £150 to the Royal Agricultural

Benevolent Institution to be allocated as five gifts of £10 each to Male Candidates, two gifts of £20 each to Married Couples, six gifts of £10 each to Female Candidates: the distribution in each class to be left until after the election to pensions by the Institution.

82. Since the fund came into existence in 1897, a total sum of £7,040 has been paid to the Institution.

Medals for Cattle Pathology.

83. In the annual examination for the Society's prizes held at the Royal Veterinary College, the Silver Medal was won by Mr. H. B. Parry, Springfields, Calne, Wilts, and the Bronze Medal by Mr. A. N. Worden, Redbank, Alverstone Avenue, East Barnet, Herts. The examination was conducted by the Professors of the College and comprised written and oral work in the diseases of cattle, sheep and swine.

National Diploma in Agriculture.

84. In this year's Examination 221 candidates presented themselves, as compared with 208 last year. Ten candidates took the whole Examination, 104 who had previously passed in certain subjects appeared for the remaining portion, and the other 107 candidates came up for a first group of subjects. Seventy-three candidates were awarded the Diploma, one with Honours. The successful candidates were:—

Diploma with Honours.

WILLIAM WILSON GATENBY, University of Leeds.

Diploma.

ARTHUR LEIGHTON ALLEN, Harper Adams Agricultural College, Newport, Shropshire.
ROBERT ANDERSON, West of Scotland Agricultural College, Glasgow.
ROBERT EDWIN ARCHER, Midland Agricultural College, Sutton Bonington, Loughborough.
GEORGE BACON, Midland Agricultural College, Sutton Bonington.
RONALD MORDAY BALFRY, Harper Adams Agricultural College, Newport, Shropshire.
PHILIP GEORGE DROVER BETHELL, Royal Agricultural College, Cirencester.
LAURENCE VALENTINE ROBERT BISHOP, Royal Agricultural College, Cirencester.
GERALD FRENCH BODMAN, Royal Agricultural College, Cirencester.
DOUGLAS GEORGE BUDDEN, University of Reading.
JOHN BULL, Lodge Farm, Hitcham, nr. Ipswich.
FRANK EDWARD BURR, South Eastern Agricultural College, Wye, Kent.
DONALD CARPENTER, Midland Agricultural College, Sutton Bonington.
BASIL RAYMOND OWTON CHILCOTT, University of Reading.
JOHN ROBERT CLAPHAM, Armstrong College, Newcastle-upon-Tyne.
JOHN COOPER, University of Reading.

Edward George Cotterill, Harper Adams Agricultural College, Newport, Shropshire.
James Easdale Craig, University of Reading.
Richard Philip Doney, Seale-Hayne Agricultural College, Newton Abbot, Devon.
Jasper Idrid Duberley, Royal Agricultural College, Cirencester.
Thomas Eaton-Evans, Royal Agricultural College, Cirencester.
Henry Owain Evans, University College of Wales, Aberystwyth.
Willie Evans, University College of Wales, Aberystwyth.
Alec Heap Fitton, University of Leeds.
Thomas Fleming, Edinburgh and East of Scotland College of Agriculture.
James Clifford Fordie, Midland Agricultural College, Sutton Bonington.
John Charles Hale, Royal Agricultural College, Cirencester.
Arthur Ferguson Hall, East Anglian Institute of Agriculture, Chelmsford.
Richard Hall, University of Reading.
Matthew John Hamlyn, University of Reading.
Geoffrey William Hart, Harper Adams Agricultural College, Newport, Shropshire.
Percy Hathaway, East Anglian Institute of Agriculture, Chelmsford.
Harry Augustus Hooton, Midland Agricultural College, Sutton Bonington.
John Hutchinson, West of Scotland Agricultural College, Glasgow.
Francis Jenkinson, Midland Agricultural College, Sutton Bonington.
Robert Peter Kensington, Royal Agricultural College, Cirencester.
Henry Vivyan Lowrance, Midland Agricultural College, Sutton Bonington.
John Luscombe, Seale-Hayne Agricultural College, Newton Abbot.
Lachlan MacKinnon, West of Scotland Agricultural College, Glasgow.
Douglas Ian McLaren, King's College, Newcastle-upon-Tyne.
Alexander MacLarty, West of Scotland Agricultural College, Glasgow.
Francis John Marshall, University of Reading.
James Mechie, University of Glasgow and West of Scotland Agricultural College.
Willie Metcalfe, University of Leeds.
Roland Phillip Morgan, University College of Wales, Aberystwyth.
William Kay Murray, West of Scotland Agricultural College, Glasgow.
Donald Victor Newill, Harper Adams Agricultural College, Newport, Shropshire.
John Newton, Midland Agricultural College, Sutton Bonington.
Reginald Milton Older, South Eastern Agriculture College, Wye, Kent.
John Parker Oliver, Midland Agricultural College, Sutton Bonington.
Peter Paine, South Eastern Agricultural College, Wye, Kent.
Norman Spencer Perfect, East Anglian Institute of Agriculture, Chelmsford.
Ralph Petherick, Seale-Hayne Agricultural College, Newton Abbot.
George Precious, University of Leeds.
Roger Arthur Pullin, Royal Agricultural College, Cirencester.
John Reid, University of Glasgow and West of Scotland Agricultural College.
Michael Marriott Richardson, University of Reading.
James Sheard, University of Leeds.
Robert John Slater, Midland Agricultural College, Sutton Bonington.
John Basil Stanier, Seale-Hayne Agricultural College, Newton Abbot.

Harry Mawer Strawson, Midland Agricultural College, Sutton Bonington.

Edward Alan Strouts, University of Cambridge.

Charles James Swan, University of Glasgow and West of Scotland Agricultural College.

James Edward Tristram, Midland Agricultural College, Sutton Bonington.

Samuel Edward Turner, Harper Adams Agricultural College, Newport, Shropshire.

John Patrick Walsh, University of Leeds.

George Weaver, South Eastern Agricultural College, Wye, Kent.

Kenneth Charlton Weedy, Seale-Hayne Agricultural College, Newton Abbot.

Eric Laurence Whitehouse, University of Leeds.

George William Wilcock, South Eastern Agricultural College, Wye, Kent.

Michael Walter Ernest Wild, South Eastern Agricultural College, Wye, Kent.

Ker Ramsey Wilson, University of Glasgow and West of Scotland Agricultural College.

Archibald John Wynne, Midland Agricultural College, Sutton Bonington.

85. Forty-two candidates passed Part I of the Examination.

National Diploma in Dairying.

86. The forty-third annual examination for the National Diploma in Dairying took place in September at the University and British Dairy Institute, Reading, for English and Welsh students, and at the Dairy School for Scotland, Auchincruive, Ayr, for Scottish students. One hundred candidates were examined at the English centre, of whom 75 were awarded the Diploma; and 49 presented themselves at the Scottish Centre, of whom 34 obtained the Diploma, one with Honours.

Following are the names of the successful candidates :—

English Centre.

Diploma.

George Henry Beard, Midland Agricultural College, Sutton Bonington, Loughborough.

Lilian May Bridgman, The University and British Dairy Institute, Reading.

Horace Haddon Brownlow, Midland Agricultural College.

May Armstrong Buck, Lancs. C.C. Dairy School, Hutton, Preston.

Frank Edward Burr, The University and British Dairy Institute, Reading.

Basil Raymond Owton Chilcott, The University and British Dairy Institute, Reading.

Muriel Ann Cole, Seale-Hayne Agricultural College, Newton Abbot, Devon.

James Easdale Craig, The University and British Dairy Institute, Reading.

Margaret Ariadne Davey, East Anglian Institute of Agriculture, Chelmsford.

Elsie Davies, University College of Wales, Aberystwyth.
Mervyn Gwilym Davies, University College of Wales, Aberystwyth.
Nora Edith Davies, University College of Wales, Aberystwyth.
Janet Lydia Davis, Studley College, Warwickshire.
Frederick William Dunnett, East Anglian Institute of Agriculture, Chelmsford.
Stanley Henry Dunnett, East Anglian Institute of Agriculture, Chelmsford.
Frances Edith Laura Epps, Studley College, Warwickshire.
John Anthony Evans, The University and British Dairy Institute, Reading.
Willie Evans, University College of Wales, Aberystwyth.
John Fairhurst, The University and British Dairy Institute, Reading.
John Simons Farmer, University College of Wales, Aberystwyth.
Nancy Mitchell Frew, Studley College, Warwickshire.
Francis John Fullbrook, The University and British Dairy Institute, Reading.
Strickland Hillary Gibson, The University and British Dairy Institute, Reading.
Leslie Norman Gingell, The University and British Dairy Institute, Reading.
Arthur Ferguson Hall, East Anglian Institute of Agriculture, Chelmsford.
Richard Hall, The University and British Dairy Institute, Reading.
Beatrice Mary Hallsworth, Lancs. C.C. Dairy School, Hutton, Preston.
Sheila Marion Hamilton, The University and British Dairy Institute, Reading.
Monica Haslam, Midland Agricultural College.
Mary Christina Hatch, Studley College, Warwickshire.
Jean Elizabeth Hayes, The University and British Dairy Institute, Reading.
Philip John Hellard, The University and British Dairy Institute, Reading.
Erica Rosa Hewett, Lancs. C.C. Dairy School, Hutton, Preston.
Fay Elizabeth Hillson, The University and British Dairy Institute, Reading.
Douglas Charles Edward Johns, The University and British Dairy Institute, Reading.
Eleanor Morton Johnson, The University and British Dairy Institute, Reading.
Gwyneth Mary Bridson Jones, The University and British Dairy Institute, Reading.
Margaret Jones, University College of Wales, Aberystwyth.
Margaret Jane Elsie Jones, University College of Wales, Aberystwyth.
Marie Jones, University College of Wales, Aberystwyth.
Mary Eluned Jones, University College of Wales, Aberystwyth.
Rhys Griffith Jones, The University and British Dairy Institute, Reading.
Marion Kitchin, Studley College, Warwickshire.
Horace Philip Ledger, East Anglian Institute of Agriculture, Chelmsford.
Nesta Margaret Lewis, University College of Wales, Aberystwyth, and The University and British Dairy Institute, Reading.
John Thomas Richardson Lockwood, Midland Agricultural College.
Jean Kerr Hamilton Lucas, The University and British Dairy Institute, Reading.
John Luscombe, Seale-Hayne Agricultural College.

Elizabeth Vere Lyon, Studley College, Warwickshire.
John Marshall Marsden, Midland Agricultural College.
Marmaduke John Matthews, The University and British Dairy Institute, Reading.
Helen Mary May, East Anglian Institute of Agriculture, Chelmsford.
Michael Francis Merchant, East Anglian Institute of Agriculture, Chelmsford.
John Macfarquhar Milne, East Anglian Institute of Agriculture, Chelmsford.
Nora Kathleen Murphy, East Anglian Institute of Agriculture, Chelmsford.
Glyn Myrddin Phillips, University College of Wales, Aberystwyth.
Geoffrey Millar Ramsden, Dairy School for Scotland, Auchincruive.
Michael Marriott Richardson, The University and British Dairy Institute, Reading.
John Raymond Robertson, Seale-Hayne Agricultural College.
Harry Rostern, Lancs. C.C. Dairy School, Hutton, Preston.
Joan Sharman, Midland Agricultural College.
Joan Rosemary Skinner, Studley College, Warwickshire.
Elizabeth Grace Small, The University and British Dairy Institute, Reading.
Norah Fanny Tanner, Studley College, Warwickshire.
Barbara Constance Taylor, Studley College, Warwickshire.
Annie Elizabeth Thomas, University College of Wales, Aberystwyth.
Mary Elizabeth Thomas, Lancs. C.C. Dairy School, Hutton, Preston.
Bessie Thornborrow, The University and British Dairy Institute, Reading.
Alice Mary Tyvold, University College of Wales, Aberystwyth.
Clare Dorothy Vernon, The University and British Dairy Institute, Reading.
John William Versfeld, The University and British Dairy Institute, Reading.
John William Vesey, East Anglian Institute of Agriculture, Chelmsford.
John Pinhey Walker, East Anglian Institute of Agriculture, Chelmsford.
Teresa Dorothy Wickens, East Anglian Institute of Agriculture, Chelmsford.
Stephen Wooldridge, East Anglian Institute of Agriculture, Chelmsford.

Scottish Centre.

Diploma with Honours.

William Wilson Gatenby, 64, High Street, Bridlington, Yorks.

Diploma.

Andrew Gardner Archibald, 17, Westonlee Terrace, Dumbarton.
Gwynneth Austin, Emrys, Kilmorey Park Road, Newton, Chester.
Anne Brodie Black, 630, Wellesley Road, Methil, Fife.
James McGregor Calderwood, Moss-side, Rora, Longside, Aberdeenshire.
Khandes Desai, Imperial Dairy Institute, Bangalore, India.
Elizabeth Margaret Wright Duff, Ardnahane, Strathearn Terrace, Crieff, Perthshire.
Millicent Isobel Duncan, Mains of Pittendreigh, Netherdale, Bridge of Marnoch, by Huntly.
Alec Heap Fitton, Boarshaw Farm, Middleton, Manchester.
James Kenneth Gaunt, 25, Armley Grange Avenue, Leeds, 12.

Thomas William Sigsworth Glover, 13, Kingsley Road, Harrogate, Yorks.
Mary Helen Gray, West Lodge, Dalvey, Forres, Moray.
Kate Margaret Harbutt, 7, The Oval, Allerton Road, Bradford.
James Lamb Hardie, 3, Eshiels, Peebles.
Geoffrey William Hart, Lodge Farm, Comberford, Tamworth, Staffs.
William Hewitt, 45, Promenade, Musselburgh, Midlothian.
John Hutchison, Station House, Dalmellington, Ayr.
Mary Drummond Langlands, 18, Brighton Place, Portobello, Midlothian.
Gavin Lawrie, Hillhead, Careston, by Brechin.
Janetta Mary Sutherland Logie, Lochend, Dykeside, Westray, Orkney.
Hamilton Alexander Montgomery, "Powburndean," Fallside Road, Bothwell, Lanarkshire.
Jessie Morrison, Easter Urray, Muir-of-Ord, Ross-shire.
Margaret Logan Pirie, Castle of Auchry, Turriff, Aberdeenshire.
Hannah Pullar, Manor Farm, Deane, Basingstoke, Hants.
John Reid, Ryesholm, Dalry, Ayrshire.
Albert Westby Graham Rose, Craig-Na-Feile, Kei-Apple Road, Sea Point, Cape Town, South Africa.
Margaret E. Russell, 21, Brookvale Avenue, Belfast, Northern Ireland.
Ahmed Safwat, 59, Tanto Street, Heliopolis, Cairo, Egypt.
James Sheard, Westfield Farm, Wrose Hill, Shipley, Yorks.
Charles James Swan, "The Knowe," Strathblane Road, Milngavie, Glasgow.
Helen Baillie Sword, 51, High Street, Selkirk.
Kathleen R. Taylor, Arnglen, Crieff, Perthshire.
John N. Turnbull, 7, Bertram Drive North, Great Meols, Hoylake, Cheshire.
Joyce Weightman, Sheraton Hill, Castle Eden, Co. Durham.

All the candidates at the Scottish Centre had been students at the Dairy School for Scotland, Auchincruive, Ayr.

The Journal.

87. After the issue next March of the annual volume now in preparation, it is proposed that the *Journal* shall appear three times each year. That is to say, for 1939–40 in May, in October, and in February. These parts will be of crown quarto size, with clearer type and on better quality paper.

The Farmer's Guide.

88. An additional article on "Pests and Parasites" is being included in *The Farmer's Guide to Agricultural Research,* which will appear as part of the next annual *Journal.* A limited number of advance prints of *The Guide* will again be on sale at 2*s.* (post free 2*s.* 3*d.*), and copies at 1*s.* will be available to the staffs and students of agricultural colleges and farm institutes through those institutions.

Research Committee.

89. Experiments undertaken for the Committee by the Rothamsted Experimental Station on the utilization of Electric

Power about farm buildings have been completed, and the report is now in preparation. A further year's work has been done on the other items of research with which the Committee is concerned. These include the Inoculation of Legumes and Cake-feeding on Grassland at Rothamsted; the investigation of Calf Diseases at the Animal Pathology Institute of the Royal Veterinary College; Grass Seeds Mixture trials at various centres in England, supervised by Professor Stapledon, of the Welsh Plant Breeding Station; Sheep Tick eradication, which is being studied by the staff of King's College, Newcastle-on-Tyne; and the Cumulative Effects on a light arable soil of various methods in the disposal of Beet Tops and Straw, on which experiments are being conducted by the Norfolk Agricultural Station, at Sprowston.

90. Progress in these investigations will again be the subject of a Report of the Research Committee to appear in the *Journal.*

Council Delegation to France.

91. At the invitation of the Société des Agriculteurs de France, a delegation from the Society, which was headed by Sir Merrik Burrell, visited Paris and other parts of France in May last.

92. The following letters which have since been exchanged between the two National Societies manifest the very cordial relations which exist between them :—

1*st June,* 1938.

DEAR MONSIEUR COURNAULT,

On me rests the very pleasant duty of writing to you on behalf of the Royal Agricultural Society of England to thank you most sincerely and heartily for the kindness and great hospitality shown by you and your Society to the Members of our Society who visited France recently at your invitation.

They returned to England much impressed by all they had seen, and deeply grateful for the warm welcome they had received. We realize the trouble that must have been taken by yourself, by Monsieur Vaucheret, by Monsieur Villard, and others to make the visit so great a success, and I would be grateful if you would convey my personal thanks to all those gentlemen principally concerned in the arrangements.

My Society is delighted to think that yet another link has been forged in the chain of mutual friendship which has connected us with your Society for so many years. And it is our earnest desire that yet another strong link shall be created in 1939, when the Royal Agricultural Society of England attains its Centenary.

Sir Merrik Burrell reports that he carried out faithfully the instructions he received from my Council to invite a delegation of the Members of your Society to visit England as guests of the Royal Agricultural Society of England at the time of the Centenary Show in the Royal Park of Windsor Castle in 1939.

In hoping full advantage may be taken of this invitation, looking forward to the opportunity of welcoming our guests, and in offering you my renewed thanks and good wishes,

I am,

Yours sincerely,

(Signed) PLYMOUTH, *President.*

MONSIEUR H. COURNAULT,

President, Société des Agriculteurs de France.

10*th June,* 1938.

MR. PRESIDENT,

I received your kind letter, for which I thank you very much.

I am happy to learn that the Delegation of the Royal Agricultural Society of England were satisfied with their visit to France: they may in turn rest assured that their visit gave us great pleasure, and that we shall retain a very agreeable memory of it.

I thank you for the honour you do us in inviting a Delegation from our Society to the Exhibition which will be held at Windsor in 1939. This invitation, which Sir Merrik Burrell was good enough to communicate to us, touches us profoundly, and it is hardly necessary to say that we accept with great pleasure.

I rejoice with you, Mr. President, to see our two Societies renew the cordial relations which they have enjoyed for so many years, and with my repeated thanks,

I am,

Yours, etc.,

(Signed) COURNAULT, *President.*

93. The following officials of the Société des Agriculteurs have been elected as Honorary Foreign Members of the Royal Agricultural Society of England: Monsieur H. Cournault, Senateur, Président de la Société des Agriculteurs; Le Marquis de Vogüé, Président d'Honneur (and Chairman at the Diner de Reception); Monsieur A. Vaucheret, Vice-Président, Administrateur-Délégué de la Société.

Sir Merrik Burrell, The Earl of Strafford and Mr. Fred Smith have, in turn, been elected Honorary Members of the Société des Agriculteurs de France.

Gold Medal for 1938.

94. For 1938 the Council have awarded the Society's Gold Medal and Honorary Membership for distinguished services to Agriculture to Sir Merrik R. Burrell, Bt., C.B.E. Sir Merrik's family has been associated with the Society since its foundation, his great-grandfather having been a member of the original Management Committee. His own connection with it began in 1905, and he has been a very active member of its Council since 1921. He occupied the Presidential chair in 1936 when the Show was held at Bristol. Since 1926 he has been Chairman of the Veterinary Committee, and he has always been keenly interested in matters affecting animal health. In 1927 he was responsible for the establishment of the London Quarantine Station, which

alone has made possible the continuance of the trade in pedigree livestock with the overseas Dominions. He personally supervised and advised on the administration of the Station from its foundation until 1934, when it was taken over by the Ministry of Agriculture. Amongst his many other activities, apart from the Society, Sir Merrik is Chairman of the Governors of the Royal Veterinary College, and he was responsible for its new constitution and recent rebuilding; he is Chairman of the Animal Diseases Committee of the Agricultural Research Council, and a member of the Agricultural Council of England.

Representation of the Society.

95. To represent the Society the following have been appointed by the Council during the past year: Colonel Wheatley, as a Member of the Lawes Trust Agricultural Committee; the Earl of Dartmouth, as representative Governor of Harper Adams Agricultural College; Mr. Lindsey Everard, as official delegate to the Danish Agricultural Exhibition at Copenhagen; Lord Eltisley, Mr. Adeane and Sir William Dampier to attend the Rural Life Conference of the National Council of Social Service at Cambridge; Major Brennan De Vine, as official delegate at the International Veterinary Congress, held in Zurich; and Professor Scott Watson, to attend the 14th International Conference of Documentation held in Oxford.

By Order of the Council,

T. B. TURNER,

Secretary.

16, Bedford Square,
London, W.C.1.

ANNUAL REPORT FOR 1938 OF THE PRINCIPAL OF THE ROYAL VETERINARY COLLEGE.

Division of Preventive Medicine.

Work carried out by the Division of Preventive Medicine of the Royal Veterinary College for members of the Society has consisted mainly of advice, and the examination of milk and blood samples for the diagnosis and control of bovine mastitis and abortion. Many enquiries have also been made concerning sterility, and a member of the staff has this year spent some time with sterility experts abroad in order to obtain information which is likely to be of help in dealing with enquiries of this nature.

Mastitis.—Chronic contagious mastitis continues to be the form of this disease most commonly met with, although other kinds of mastitis, not susceptible to the same control measures, have not been uncommon. Experiments on the treatment of the chronic form of mastitis by udder injection, to which reference was made in a previous report, have led to the conclusion that some 60–80 per cent. of latent or early cases can be cured, but that treatment of advanced cases is satisfactory only in a small percentage. Experimental treatment of this form of mastitis by oral administration of some recently discovered chemical agents, which have been found active in other streptococcus infections, is proceeding.

Pneumonia of Calves.—Reference was made in last year's report to the work of the Research Institute of the College on diseases of young calves, which is financed in part by the Society. In a preliminary survey on the causes of death in a random sample of 100 calves, it was found that, while "white scours" held first place, pneumonia was also an important cause of morbidity and death. The bacteria associated with these cases of pneumonia have now been examined more intensively and in particular the organism known as *Corynebacterium pyogenes*, which belongs to the same bacteriological group as that which is responsible for diphtheria in man. One of the problems facing the bacteriologist is the manner by which bacteria produce their effects on animals. In the case of *C. pyogenes*, this has hitherto been somewhat of a mystery, but now, by special technique, it has been possible to show that the organism excretes a toxin, in much the same way as the tetanus bacillus, for example, is known to do. This finding is likely to have practical

importance in vaccinating or protecting stock from the effects of the organism and the point is now being subjected to further investigation.

Ovine Mastitis.—An investigation of a similar nature has also been engaging the attention of the Institute. Mastitis in sheep is often due to a particular variety of *Staphylococcus* and this organism also is known to produce a toxin. By chemical treatment, it is possible to alter this toxin so that, while it loses its poisonous properties, it retains its power of stimulating resistance. By inoculating sheep with this altered toxin—or toxoid, as the product is called—it has been found that they can be in large measure protected from the effects of the staphylococcus when cultures of this germ are injected up the teat canal of the ewe's udder. Further work on this subject is proceeding.

Other problems at present being studied include cirrhosis of the liver in pigs. This disease is shown by a hardening of the liver tissue, so rendering the organ less useful to the animal and valueless as an article of human food. The wastage in abattoirs from this cause is considerable. The condition is quite possibly connected in some way with the diet, and attempts are being made to throw some light on the subject.

Animal Husbandry Department.

Numerous requests for advice have been dealt with by the department during the past year, especially concerning the suitability of various feeding stuffs.

Castor Seed Poisoning.—There appears to be a general difficulty in finding a satisfactory market for seed residues resulting from the extraction of oil from certain of the oleaginous seeds, such as castor seed, rape seed, etc. Some of the residues are rich in protein, and were it not for the presence of toxic substances, might be useful as cattle cakes or extracted meals, in the same way as cotton seed residues are used. The presence of harmful substances, however, renders them undesirable for this purpose.

The increasing use of castor oil in commerce as a constituent of lubricating compounds, as a "doping" agent for aerofabrics, as well as for medicinal purposes, has increased considerably the amount of residue available during recent years. It appears that in some instances a small percentage is finding its way into some of the compound cakes at present on the market. If well mixed, a small amount may not be attended with harmful results, but there is a risk where mixing is not thorough; a few cakes, or perhaps only one cake in a batch, may contain a "pocket" of castor seed residue which would readily prove

fatal to a cow or bullock if eaten at a single meal. Analysis of other cakes in the same batch, in such an instance, gives no indication of the presence of anything abnormal (unless the sample happens, quite by chance, to contain a similar "pocket").

Occasional deaths in a herd of cattle, from symptoms which are strongly suggestive of castor seed poisoning, in such cases remain undiagnosed.

It would seem that, when farmers are purchasing compound cakes or meals, they should require a guarantee that these contain no castor seed or rape seed residues.

Minerals in Drinking Water.—Several instances have occurred recently in which municipal authorities have installed water softening systems. Animal owners, bearing in mind that a medium hard water containing about 15 to 20 degrees of total hardness is generally regarded as being best for farm stock, have consulted the College regarding the possible effects of using softened waters for their stock. The amount of calcium and magnesium in even hard waters (25 to 30 degrees) is only a fraction of the intakes required for normal physiological function of the animal body. It is evident, therefore, that, provided the water is otherwise safe, the lime content does not greatly matter as a source of minerals. The greatest intake of the essential minerals always comes from the food. Should there be a doubt, it is much safer to reinforce mineral intakes by adding to the ration a supplementary supply of minerals, in the form of a good quality bone meal or bone flour, or perhaps in the form of a mineral mixture, made as complete as our present knowledge will allow.

"Veterinary" Cod Liver Oil.—An investigation is in progress regarding the effects of using cod liver oils of good, medium and poor quality for pigs. Reference has already been made in these reports to the desirability of using only oils carrying a guarantee of vitamin potency. The use of the word "veterinary" to describe a brand of cod liver oil is, unfortunately, no guarantee that the oil in question is a reliable product. There are still brands upon the market which are sold as "veterinary cod liver oils," which are not only unsuitable, but may be actually dangerous for pig or poultry feeding. Work on this is still in progress, but it is too early to form any definite conclusion.

Pregnancy Diagnosis.—Enquiries have been dealt with concerning the diagnosis of pregnancy in mares. It is hoped to publish at a later date the results obtained by a comparison of three different methods. In the meantime it may be pointed out that no one method, of those used at present, will give 100 per cent. accurate results.

Clinical Department.

A number of Members of the Society have been in consultation with the clinical department of the Royal Veterinary College and advice has been given on a variety of subjects including the following: Periodic Ophthalmia; Worm infection; the use of X-rays and their applicability to conditions of the hip and elsewhere; swine erysipelas; pneumonia in young stock, telegony and Johne's disease.

Foot-and-Mouth Disease.

At about this period (December) last year stock owners found themselves face to face with one of the most severe and widespread invasions of foot-and-mouth disease that has been experienced for some time past. The epizootic was coincident with outbreaks of similar severity but more devastating proportions in several continental countries, notably France, Belgium, Holland and Germany. It was pointed out at the time that when the disease is widespread on the Continent, and especially when the responsible virus is of a virulent type, its spread to these shores is almost certain. Thanks to the policy adopted by the Government and to the highly efficient manner in which it is applied, we have been spared the serious economic effects of a widespread invasion such as has been experienced in many continental countries. The following comment on the control of foot-and-mouth disease in this country, which appeared in a recent issue of the "Bulletin de l'office International des epizooties," is an eloquent tribute to the efficiency of our sanitary police measures "La tactique suivie par le Ministère depuis le 16 Octobre a été soumise à une rude épreuve. Elle a triomphé de tous les obstacles et cette courageuse campagne, poursuivie avec une inlassable ténacité, fait le plus grand honneur au service vétérinaire britannique. Le total des indemnités allouées aux propriétaires pour l'abatage des animaux dans les 267 foyers confirmés depuis le 16 octobre, s'élève à 344,721 Livres, somme insignificante si on la compare aux pertes subies dans les grands pays envahis du continent."

In the early part of this year it seemed that the incidence of the disease was declining on the Continent, as it certainly was in this country. From official returns covering the six months period April to September, it is evident that the disease has in fact spread and covered a very wide area in Europe, while in certain of the countries in which the number of infected premises was decreasing, there appears to have been a further wave of infection. The following table illustrates the wide-spread nature of foot-and-mouth disease in Europe, the grave incidence of

Outbreaks of Foot-and-Mouth Disease in European Countries and Great Britain.

Month, 1938.	Austria.	Belgium.	Bulgaria.	Czecho-slovakia.	Denmark.	Estonia.	Finland.	France.	Germany.	Italy.	Latvia.	Lithuania.	Netherlands.	Norway.	Poland.	Roumania.	Sweden.	Switzerland.	Yugoslavia.	Great Britain.
April ..	25	1,427	Nil	1,815	27	Nil	Nil	9,225	26,340	337	Nil	Nil	524	Nil	921	Nil	Nil	41	1	35
May ..	442	1,640	Nil	4,548	41	Nil	Nil	10,341	48,338	375	Nil	Nil	741	Nil	6,364	Nil	1	41	752	4
June ..	1,851	1,775	Nil	18,111	193	Nil	Nil	14,926	107,246	502	Nil	Nil	784	Nil	19,856	Nil	Nil	27	5,637	3
July ..	4,977	2,976	Nil	60,558	741	Nil	Nil	29,905	133,316	493	Nil	Nil	1,820	Nil	42,237	Nil	Nil	13	15,709	2
August	4,569	6,937	Nil	79,460	4,801	Nil	Nil	46,219	126,898	—	Nil	Nil	6,094	Nil	66,315	63	2	4	26,800	3
Sept. .	2,814 (1–15)	3,642	—	22,384 (1–15)	—	—	—	30,184	66,600	—	—	3	—	—	—	1,179	89	114	24,732	2

infection in several of the countries and the relative immunity to invasion by the virus which Great Britain has fortunately experienced.

Methods of Introduction of Infection.—When the outbreaks first occurred in the Eastern counties in the autumn of 1937, it seemed to be highly probable that some hitherto unconfirmed channel of entry was responsible for the invasion. It was clear that the usually suspected routes of infection, most of which are adequately guarded against, were unlikely to be responsible, and it was suggested that, having regard to all the circumstances, migrating birds such as starlings might have been responsible for introducing the virus in the first instance. While it is true that there is as yet no direct evidence that starlings are responsible, there is an accumulation of facts which render these birds susceptible to suspicion. For example, it is calculated, from the average speed of the starling on migration, that the birds could easily reach the Eastern counties within 9 or 10 hours of leaving Germany. Experiments have shown that when the feet and feathers of live starlings were contaminated with virulent material the virus could survive on these sites for at least 48 hours. Birds have been recovered in Devon that were ringed in Latvia and four birds shot in Berkshire, Northampton, Lincoln and Wiltshire had rings indicating their origin as Rossiten, East Prussia, while one shot at Spalding had a ring indicating its origin as Leiden, South Holland. Several hundreds of starling carcases obtained from various parts of the country, many of them from areas in which outbreaks of foot-and-mouth disease had recently occurred, failed to reveal any evidence of the virus when tested biologically. This suggests that these birds do not play an important part in disseminating infection from one area to another in the case of outbreaks of disease in this country, which is not surprising in view of the fact that immediate steps are taken to prevent the escape of massive amounts of infective material. It does not necessarily follow, however, that they may not carry the virus mechanically by contamination with infected mucus, etc., when circumstances permit of such liberal contamination as must occur on the Continent. Further, it has been shown experimentally that when starlings are fed on contaminated material, the virus of foot-and-mouth disease can be demonstrated biologically in their droppings.

The relative freedom of this country from the disease during the six-months period referred to previously, which includes the peak of holiday traffic, may be taken as indicating that the precautions which have been adopted are a highly efficient safeguard against the introduction of infection by the ordinary channels.

Scheduled Diseases.

During the year there has been an unfortunate increase in the number of outbreaks of Foot-and-Mouth Disease and Anthrax, while Parasitic Mange, Sheep Scab and Swine Fever have shown a very satisfactory decrease.

Foot-and-Mouth Disease.—In the case of Foot-and-Mouth Disease the figures were :—

Year.	Number of outbreaks.	Animals slaughtered as diseased or exposed to infection.
1934	79	10,302
1935	56	12,444
1936	67	5,316
1937	187	31,188
1938 up to Nov. 30th	176	22,338

Bovine Tuberculosis.—The following Table shows the number of animals slaughtered under the Tuberculosis Order of 1925.

Year.	Animals slaughtered.
1934	22,009
1935	22,203
1936	23,716
1937	22,425
1938 to March 31st	5,393

Anthrax.—In the case of this disease the figures are in excess of those for last year.

Year.	Outbreaks.	Animals attacked.
1934	395	453
1935	386	443
1936	468	551
1937	743	879
1938 to Nov. 30th	752	1,142

Swine Fever.—The figures reveal a further decrease.

Year.	Number of outbreaks.
1934	1,832
1935	2,049
1936	1,873
1937	982
1938 to Nov. 30th	831

Sheep Scab.—The favourable position noted last year has continued, and the outbreaks of this disease have shown a steady yearly decrease since 1934.

Year.	Number of outbreaks.
1934	684
1935	477
1936	255
1937	253
1938 to Nov. 30th	184

J. B. Buxton.

Royal Veterinary College,
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ANNUAL REPORT FOR 1938 OF THE CONSULTING CHEMIST.

At the beginning of the year the Council appointed me consulting chemist to the Society in succession to my uncle, the late Dr. J. A. Voelcker. It is indeed a great honour to me to serve the Society in this capacity, more especially as I am the third generation of my family to hold the post, thus continuing unbroken a record of already some 81 years. I am proud of this position and I will do my utmost to serve the Society to the best of my ability, and endeavour, at the same time, to enhance the prestige of the Society, so well maintained by my two predecessors.

In this, my first Report, I feel that I cannot do better than continue on the lines adopted by my uncle (but perhaps not at such great length). I shall continue to deal with matters of general interest to farming, and, finally, with the actual work of the laboratory.

This year marks a great change in the privileges afforded to members of the Society in that now the services of the laboratory are given free to members who are not engaged commercially in the manufacture or sale of the particular article submitted for analysis. It was contemplated that there would be a substantial increase in the number of samples sent, and it is satisfactory to note that this hope has, in some measure, been realised. The number of samples submitted by members during the twelve months is 127 as against 103 in 1937. In addition to members' samples, 45 samples of Cider were analysed in connexion with the Society's Show at Cardiff.

Fertilizers and Feeding Stuffs Act, 1926.—In July of 1937 the Minister of Agriculture received a deputation from the Society asking that such alteration of the Act be made as would make it really useful to the farmer. The Minister, although he promised to consider carefully the points laid before him, replied some eleven months later that it was not intended to proceed with the amendment of the Act on the lines suggested. The Chemical Committee considered this reply to be most unsatisfactory and recommended that yet another deputation should be appointed to call upon the Minister.

On October 26th of this year the Minister received this deputation, which strongly urged that the present Act was unworkable and did not justify the large sums of money spent on its administration. The Minister replied that a strong case had been made out and it is to be hoped that soon some amendment of the Act will be made or, better still, fresh legislation introduced.

Land Fertility.—Members of the Society have received the pamphlet on Lime and its use on the land. It is true that in many parts of the country there is a sad deficiency of lime and that remedial doses have restored the land to good heart, but I do feel compelled to point out that the liming of land can be overdone. What the land needs in many cases is the "muck" cart first, followed by liming. The fertility of the soil will never be maintained if the humus is not properly built up. With the garage rapidly superseding the stable, and with the increasing difficulty in obtaining sufficient farmyard manure, other sources of humus have to be investigated.

I have recently come in contact with a product (now on the market) which, I feel confident, will prove of the utmost benefit as a source of artificial humus. At the moment exhaustive field trials are being carried out. This material is the product made from the disposal of household refuse but does not, as one might at first suppose, consist mainly of clinker, broken glass, paper and tins. The bulk of the cinder and clinker are screened out and the glass, tins, crockery, rags and some of the paper picked out by hand. Small proportions of these will naturally get past the pickers into the finished product, but the particles will be very small and will not be of any consequence. As far as possible the product consists of the organic matter contained in the original household refuse. The product is non-odorous, clean to handle, and in fairly fine state of division. The preliminary results of field trials indicate that it is of about the same value as dung, and, as such, is a material that may become of great importance not only to farming, but to market garden production and to horticulture.

Manures and Feeding Stuffs.—The price of fertilizers has been steady during the year, the prices being in all cases practically those ruling at the corresponding time last year. There will, consequently, be no change in the unit prices of Nitrogen, Phosphoric Acid, or Potash in the compensation tables.

Feeding stuffs, on the other hand, have gradually cheapened during the year except at the time of the National Emergency when there was a sharp rise in prices, the most marked differences in cost noticed being in Barley Meal, now at £6 5*s*. 0*d*. per ton, as against £8 17*s*. 6*d*. a year ago; and Sussex Ground Oats, now at £7 10*s*. 0*d*. a ton, as against £10 15*s*. 0*d*. a year ago. Linseed and Cotton cakes, however, have remained fairly steady.

Castor Oil Bean.—Members of the Society must all be familiar with the experience of my late uncle, which definitely proved the harmful properties of the Castor Oil Bean, even in quite

minute quantities, in cattle food. Cases of mysterious illness and sometimes death have again been reported, with the subsequent finding of Castor Bean husk in the feeding stuff used. If merchants and farmers would firmly put "their foot down" and say "We will not buy cakes or meals containing Castor in any amount," then, I feel, we would once again have pure and safe feeding stuffs. All the work of the Chemical Department and of other agricultural chemists will be wasted if the farmer persists in running the risk of having a small amount of Castor Bean in his feeding stuff for the sake of getting an article at a cheaper price. It is a much cheaper and wiser policy to buy on guarantee that the cake is entirely free from Castor than to run the risk of losing stock and either getting no compensation or having to fight a case in the County Court for recovery of damages.

I now come to matters of interest arising from the work done in the Society's Laboratory during the year.

A striking feature was the number (43 out of a total of 127) of samples of water sent for analysis. The large increase may have been due partly to the recent water scare, but several were sent by members who were taking the precautionary measure of having the water supply tested before purchasing new property.

One member sent a sample of water which had been condemned by the local authority as unfit for drinking. On examination, the sample proved to be satisfactory, both chemically and bacteriologically, and, as a result of enquiries I made, it was found that the analysis for the local authority had been made by a pharmacist who was obviously (from perusal of his report) unfamiliar with water analysis. The member might have been put to needless trouble and expense regarding a new supply had he not exercised his privilege and had samples analysed at the Society's laboratory.

In June, a sample of water from an ornamental lake, in which a very large number of fish had died, was sent for examination, poisoning being suspected. A sample from the brook which fed the lake was also sent. In the brook water were live Daphnia and one or two tadpoles, whereas the deep-yellow-coloured lake water was devoid of pond life. The lake water was tested and found to be devoid of dissolved oxygen whilst the brook water was satisfactory. Live goldfish were put into two small tanks, one containing lake water and the other brook water, with air constantly bubbling through, and were kept alive successfully. This pointed to the death of the pond fish as being due to the deoxygenation of the lake water. This deoxygenation had been set up by the drop in the volume of the lake water, owing to the drought, and the subsequent disturbance,

by a rise in temperature, of the mud bottom containing decaying vegetable matter which had caused a liberation of gas (probably sulphuretted hydrogen); what was most needed to improve the condition was a heavy rainfall. A biologist at a London hospital confirmed the opinion, after examining some of the dead fish, that the cause of death was suffocation due to lack of oxygen. The deoxygenation of the water must have been very sudden as the fish were in sound condition, and, in many cases, actually feeding at the time of the disturbance.

Another member sent, in July, a sample of water from a brook into which sewage was discharged and from which his cattle had to drink. He had complained, but the local council told him that the effluent discharged was pure. I reported the sample sent me as being a thoroughly bad one, and as one to which cattle should not have access. When the member communicated this to the council they replied that the sample must have been an exceptional one. He, therefore, in September, to prove that this was not so, sent a further sample for analysis. The results obtained were even worse than before. The water approached the nature of crude sewage and was quite unfit for cattle to drink.

In connexion with the Land Fertility Scheme a member submitted a sample of Lime for analysis. It was a very good sample having a caustic lime (CaO) content of 85·68 per cent.

Another member sent three samples, two of Slack Lime and one of Lump Lime, made from local Cotswold stone. The comparative caustic lime contents were as follows :—

	Best Screened Slack Lime. per cent.	Lump Lime. per cent.	Second Grade Slack Lime. per cent.
Caustic Lime (CaO)	34·16	85·40	19·04

The figure for the caustic lime is determined by the solubility of the sample in a 10 per cent. solution of cane sugar and must not be confused with the total lime content. This latter is quite a different thing, containing, as it does, other forms of lime which are not caustic in nature.

The samples of Lump Lime generally are satisfactory and up to the guarantee given, with reasonable allowance in some instances. It is on the ground limes, however, that I repeatedly have to make an adverse comment. In several cases, either owing to bad burning or storage, there was found a large amount of carbonate of lime. Clinker, coke, and pieces of coal were also found to be present in quite appreciable quantities in some samples.

A sample of Lawn Sand was submitted for analysis by a member who considered the price he had paid for it (25*s*. 6*d*. in cwt. casks) rather high. The analytical figures were :—

Sand	33·0
Sulphate of Ammonia	30·0
Sulphate of Iron Crystalline (Green Vitriol) ..	30·0
Bone Flour	7·0
	100·0

My opinion was that the price charged was too high and that, packed in casks and delivered free, the price should be 20*s*. a cwt. Taking the value of the actual ingredients at the time the sample was received, the cost of these alone did not exceed 90*s*. a ton !

A sample of Groundnut Cake guaranteed 65 per cent. Oil and Albuminoids together, and costing £7 15*s*. a ton, was submitted. On analysis the sample gave Oil 10·70 per cent., Albuminoids 49·12 per cent. As 59 per cent. Oil and Albuminoids Groundnut Cake cost, at the time, £7 2*s*. 6*d*. per ton on rail, the member was being asked to pay rather a high price for what he was getting. A further sample was analysed and gave 11·71 per cent. Oil and 49·13 per cent. Albuminoids (60·84 per cent. Oil and Albuminoids together). On taking up the matter with the suppliers, an allowance of 7*s*. 6*d*. per ton was made.

Another member sent me analysis figures of "Horse Gram," an Indian legume, asking my opinion on it as a food for cattle, sheep, and pigs in this country. The material is largely used in India as cattle food, and the crop is grown both for fodder and for the seed.

I suggested to the member that he should, if possible, get an actual sample of the Gram so that I might examine it for probable harmful properties. He was able to obtain a sample which gave the following results on analysis :—

Moisture	9·57
Oil	·43
*Albuminoids	22·87
Carbohydrates &c.	58·63
Woody Fibre	4·93
**Mineral Matter (Ash)	3·57
	100·00
*containing Nitrogen	3·66
**including Sand and Silica	·60

The material was what is known as "Horse Gram" (*Dolichos biflorus*) which is quite distinct from the common Gram or Chick

pea (*Cicer arietinum*). At times it has been imported into this country, but, I am told, not for a number of years. The sample was free from cyanogenetic (prussic-acid forming) glucosides, and, from the analysis made, would appear to be quite a suitable seed for grinding and adding to animal foods, and is of about the same feeding value as peas.

The question of its use in this country would seem to depend on the cost of transport from India, and, if it could be had, delivered, at a cheaper price than peas or beans, it would be worth a trial, but not otherwise.

The following is a list of the samples submitted during the 12 months 1st December, 1937 to 30th November, 1938 :

Linseed Cake	1
Groundnut Cake	3
Compound Feeding Cakes and Meals	18
Cereals, Offals &c.	14
Dried Grass	1
Sulphate of Ammonia	2
Compound Manures	2
Basic Slag	1
Shoddy &c.	5
Lime, Chalk &c.	10
Milk	4
Waters	43
Soils	14
Miscellaneous	9
	127

ERIC VOELCKER.

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ANNUAL REPORT FOR 1938 OF THE BOTANIST.

NINETEEN THIRTY-EIGHT provided an outstanding example of the dependance of our system of agriculture on weather conditions. With a well distributed and average rainfall and temperatures ranging, without excessive fluctuations, from a winter minimum to a summer maximum and then falling gradually to the minimum again all goes well. The routine work of cultivation can be carried on to a fairly definite time-table and satisfactory crops can be anticipated. But in this year the climatic conditions were far from the normal. In fact, they provided a long series of meteorological records which made the results of the usual farming technique, particularly on arable land, a gamble in which the odds were ultimately found to be well against the farmer.

The year started badly for those on the heavier types of soil for, owing to the lack of winter frosts, it was difficult and occasionally impossible to get the land into a fit state for spring sowing. By the time this was accomplished much of the soil moisture had disappeared from the seed bed and germination was retarded and irregular, with the result that the spring-sown crops often made a bad start.

March, however, was a particularly genial month with temperatures often over 60° F. and an average of 6° F. above the normal. The established crops made rapid growth in spite of a scanty rainfall, and by the end of the month vegetation was in an unprecedentedly forward condition. Fruit trees provided the most striking example of the earliness of the season, for by April 1st early varieties of apples and pears were in blossom in some of the Eastern counties, whilst a week earlier one Member had reported that he was beginning to spray apples, then at the "pink bud" stage.

A succession of sharp frosts beginning in the second week of April brought this burst of growth to a sudden standstill. Fruit trees, bush fruits and strawberries suffered severely, the lush foliage of wheat was frostbitten, bean flowers were blackened and killed and seedlings of brussels sprouts and cauliflowers were damaged. Even grass, which appeared to be getting away well, then ceased to grow.

Meanwhile, the drought continued and the low relative humidity accompanying it (below 45 per cent. on most days during March and April and occasionally as low as 30 per cent.) resulted in a rapid drying out of the surface soil. By the middle of May it was evident that the soil moisture was

inadequate for the grass crop and that where any could be expected the yield would be a light one. The clovers, too, suffered, the perennial sainfoin perhaps least of all.

From then on until harvest time the rainfall over much of the country was considerably below the normal, and too low for the requirements of most of the crops. But the conditions suited the wheat crop, and thanks in part to the lack of bad outbreaks of yellow rust it produced an over-average yield. Barley, also a drought-resisting crop, was very variable. Where autumn sown it yielded well and often gave grain of excellent quality. But much of the spring-sown barley, though it made better growth than was anticipated in the early summer, and finally produced an over-average crop, finished badly with the result that much of the grain made little appeal to the maltster. The potato crop owed much to the autumn rains and proved much better than the number of partial failures seen earlier in the year led one to expect. But sugar beet, except where subsoil moisture was available, did not produce crops comparable with those of last year. For instance, on one farm on which it is particularly well grown the yield was only seven and a half tons, whereas in the previous year it was 16. The sugar content, too, was lower.

After the harvest the weather conditions were favourable for cultivation, and a sufficiency of moisture in the surface soil ensured the early germination of the autumn sown cereals. Then abnormally warm weather set in in November, the temperatures for the first half being about the average for May. The crops grew so rapidly that, in the case of the earlier sowings, the foliage was meeting across the drills by the middle of the month. By then the question was being asked whether such forward crops, especially of barley, could be expected to stand the winter, and the spring-time problem of sheeping off winter proud cereals was being considered.

Seed Testing.

Samples of the seeds of market garden crops for the first time outnumbered those of the ordinary agricultural crops, the numbers being 18 and 15 respectively. Seeds of garden peas, onions and parsnips constituted the first group. The peas provided some of the worst germination figures for some years. At one period six samples were under test. Their germinating capacity ranged from three to 73 per cent. The best sample was the only one worth sowing—and then only, as the report on it had to suggest, if the normal seed rate was doubled to make up for the feebleness of a considerable percentage of the seedlings. In spite of the differences in the germinating capacity the appearance of the samples was much the same, and even

after the results of the tests were known they could not be put into their order of germinating capacity by eye judgment.

The agricultural seeds were samples of broad red clover, swede which had been carried over for two seasons and still germinated 90 per cent., and cereals, one of which was of some interest. This was a sample of Spratt Archer barley drawn from a bulk purchased in February, 1938. It could not be drilled then and the question arose whether it could be used for autumn sowing, as it had been dressed with a mercurial fungicide before delivery.

Its germinating capacity was found to be 92 per cent., and the seedlings, which were kept under observation for a month, showed no signs of abnormal growth.

WEEDS.

Enquiries about the identification and control of weeds accounted for more of the correspondence than usual. It was noteworthy that most of the specimens were grass-land weeds. The list, containing such weeds as rest-harrow, dyers' weed, knap weed, silver weed, scabious, tor-grass and yarrow, is in itself sufficient to indicate the type of field from which they had been gathered. They all help to form the vegetation of much of the semi-derelict grass-land on the heavy soils. The inspection of some fields largely consisting of rest-harrow led to a survey of several areas in which the soil was either gault or boulder clay. The history of the fields was generally that they had been ploughed out during the food production campaign in 1916, and after carrying two cereal crops they had either been sown down to grass again or more usually allowed to "revert" to it. One area, well known to me personally, was useful arable land in the nineties of last century. It went out of cultivation when profitable wheat-growing became impracticable, and developed first into a rough grazing and, by 1915, into a hawthorn scrub in places 15 feet high. Prisoners of war cleared this and for a few years it grew excellent crops of wheat. It then went back to grass and is now once more well on the way to scrub.

A similar fate awaits much of this type of land unless steps can be taken to bring it into cultivation again. The weeds sent in for identification had suggested that the fields were becoming derelict, but gave no indication of the fact that the most serious trouble was the growth of hawthorn. This shrub establishes itself slowly, but once a small plant has got a hold it can grow more rapidly than it is usually given credit for. In a few years it becomes difficult to stock out or even to drag out with tractors, and if the land is well infected its cleaning will then probably cost more than it is worth.

Some of these weed-ridden fields could be improved by systematically mowing the worst patches, manuring and grazing. Those farming them must decide whether this is worth doing, taking into consideration the fact that no crop gives a poorer return from the land than indifferent grass. Most of them, however, should undoubtedly be ploughed out at the earliest opportunity in order to get rid of the hawthorn before it becomes unmanageable. The subsequent management of the land will again be determined by economic considerations. If the minimum of expenditure on labour is the outstanding factor then resowing with the object of producing a more productive pasture is indicated. In this case, the seeds mixture should be a simple one with perennial ryegrass as the chief constituent and an allowance of one and a half pounds per acre of the seed of wild white clover. A dressing of basic slag should then ensure better grazing for a year or two than these fields have hitherto provided.

The fact, however, is worth recalling that much of this land was kept under cultivation until nearly the end of last century by cropping with wheat and beans. Since it went semi-derelict two fresh features, which should go far to make such cultivation possible again, have come into existence. One is a stable price level for wheat, the other the lessening of the cost of tillage which tractor-ploughing has brought in its train.

The destruction of bracken was the subject of some correspondence. There has been a good deal of experimental work done on the subject, and now a comparative examination of the various methods which have been employed would be useful. At present, one occasionally hears a method, known to be satisfactory in some districts, roundly condemned as useless. Probably in such cases it is not the method but its carrying-out which should be blamed. The two essential points to observe in controlling bracken are to cut it for the first time when the fronds are from one half to three-quarters of the size they would become if allowed to develop, and not to attempt to destroy a greater area in any one season than can be thoroughly handled. Where this involves a choice of area the attack should be made on the advancing front rather than on the older established portions.

There was no mention of the weed which dominated all others in the list for 1937, namely, ragwort. The general impression left after visiting districts in which it is usually overabundant was that it was distinctly less prevalent than usual and that its parasite, the caterpillar of the cinnabar moth, was plentiful enough to provide a severe check on its spread.

A specimen of the false Brome grass, sent in under the local name of "tor-grass," though too scanty for conclusive identification, was almost certainly *Brachypodium sylvaticum.*

It spreads extensively by means of creeping rootstocks, and produces a large amount of foliage which is generally left ungrazed. Its eradication would probably involve ploughing out.

PLANT DISEASES.

The partial destruction of the fruit crop by spring frosts more or less eliminated the usual enquiries about spraying problems and the control of fruit diseases. Relatively light attacks of the commoner diseases of crops, with the possible exception of those attacking the potato, seem to have been general. Nevertheless, the cereals provided about the normal number of enquiries, especially during the harvest period. The most frequent were those referring to "Take-All," on which an article had appeared in the last volume of the Society's Journal. Most of the specimens showed unmistakable symptoms of the disease, but some of the barley specimens, though superficially looking as if they had been attacked by the Take-All fungus, were in reality almost killed by the severity of the drought. The patchiness of the crop, so generally associated with the parasite, was in these cases brought about by the occurrence of dry, gravelly areas in the fields. The severity of the disease on wheat appears to have been similar to that in the previous season, in spite of the difference in climatic conditions. But there were a number of unusually severe attacks on barley in Norfolk.

The troublesome outbreaks of Botrytis on over-wintered lettuce crops, which have been mentioned in previous reports, were traced to inadequate ventilation of the frames in which the plants were sheltered in the winter months. Plants for experimental crops were wintered (*a*) in a badly ventilated frame, (*b*) in a frame receiving normal ventilation, and (*c*) under very dry conditions in an exceptionally well ventilated alpine house. The plants grown in the badly ventilated frame were so severely attacked that transplanting to the open seemed to be a waste of effort. About one half of the plants wintered under normal conditions of ventilation were attacked at varying intervals after being set out in the open, whilst practically all of the plants over-wintered in the alpine house reached maturity with no signs of decay. It is thus very probable that the outbreaks giving rise to this enquiry were due not to damage and weather conditions at planting time but to pre-transplanting conditions.

The only other disease due to Botrytis which was received during the season was the chocolate-spot of beans. This was a great contrast to the previous year in which the fungus was reported on an unusually large number of host plants.

Among the enquiries customarily classed as "general" in the annual report of this Department were a number evidently

prompted by articles in the press. Three of these dealt with a method of growing plants without soil. The technique described was obviously one which has been in use in botanical laboratories for half a century. It was devised primarily for investigating some of the problems of plant nutrition. Important as the method is scientifically, its value to the practical agriculturist is negligible.

Soya beans were again responsible for a good deal of correspondence, some of which was of particular interest as it provided information on the results of small scale trials made in widely separated districts to test their suitability as a farm crop. That certain varieties can be grown in this country is clear, but so far no one has reported that they can be grown with any likelihood of a profitable return. A few varieties from Japan grown here this season were a complete failure.

The demand for information on the characteristics of newly introduced varieties of various crops continued.

The further development of the methods for testing the yielding capacity, the quality and other characteristics of the different crops now permits of reliable assessments of their value, and the extension of the trials to different parts of the country has made them still more valuable. They have not only made it clear that a novelty is not necessarily an improvement on existing varieties, but have done much to suppress the re-introduction of the latter under new names.

Amongst the miscellaneous plants identified was one described as "growing wild in parts of Austria and Sweden and in great demand by cooks for flavouring purposes." The information, rather than the specimen, which consisted of two inches of dried up stem and a leaf sheath, established the identity of the plant as fennel and made it possible to provide the information required. Another unusual specimen was the edible morel fungus (*Morchella esculenta*) with which was a second closely related species, and an enquiry as to whether it, too, could be eaten with safety. As a book dealing with the cooking of fungi included it among the edible species it seemed safe to quote it and suggest a small scale trial.

The total number of enquiries was again smaller than in the previous season, being 109 as against 112 in 1937. This was anticipated, for when conditions are at all out of the ordinary many troubles find an obvious, though possibly incorrect, explanation in the weather. Yet this only partially accounts for the falling off in the demand for information, for it has now been in progress for several years.

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ANNUAL REPORT FOR 1938 OF THE ZOOLOGIST.

As is always the case, the incidence of insect pests during 1938 was strictly governed by weather conditions. The mild and open winter did nothing to discourage the usual pests of that season, and wireworm, leatherjackets, snails and, in wheat-crops, frit-fly and mud beetles, were all at work.

In the early spring the cold dry weather and the unusual difficulty of obtaining a good tilth for spring-sown crops were of far more importance than any insect depredations. Later on, the outstanding feature was the almost simultaneous appearance on practically every kind of crop of its appropriate species of aphis. The bean aphis, which is at home on various plants besides beans, was especially prevalent, and its occurrence to an injurious extent on sugar beet was the cause of considerable anxiety.

During the summer two points which attracted attention were the exceptional severity of attacks by the asparagus beetle, and the numerous cases of damage to various crops by cut-worms.

The pests usually reported in the autumn seemed this year to be much less prevalent than usual, celery-fly, for instance, being almost absent in most districts.

Cereals.

In view of the very fine wheat crops obtained nearly everywhere this year, the insect pests were evidently not very important. Nevertheless all the usual pests were complained of in one quarter or another, wire-worm and frit-fly in the winter, wheat bulb-fly, stem saw-fly and thrips later in the year.

The spring sown crops had to contend with such unprecedentedly unfavourable conditions at the time of sowing that failure, where it occurred, was adequately accounted for. Late-sown oats are notoriously subject to bad attacks of frit-fly. This year, indeed, there was less trouble from the June attack than had been anticipated, but the second brood which attacks the ear was conspicuous in some districts and must have distinctly reduced the yield of the crop.

Barley, the crop most affected, apparently, by the bad weather conditions at seed time, was also reported to be attacked by gout-fly.

Farm and Garden Crops.

Certain pests were more prevalent than usual this year. Among them may be mentioned the asparagus beetle, whose attacks were extremely severe in some districts, and cut-worms, which attacked many crops, and in one case were injuring grass. The species most frequently concerned was the turnip-moth, *Agrotis segetum*. But the most striking feature of the season was the almost simultaneous appearance of aphis on all crops. Especially severe was the incidence of the bean aphis, *A. rumicis*, on various varieties of beans, but also on swedes, mangolds and sugar beet. It was not until 1937 that this pest had been observed to be injuring sugar beet, and the present severe attack caused considerable concern and anxiety for the future.

It is a very common experience that an insect pest very abundant one year is practically absent the next, having been almost exterminated by parasites and unfavourable weather conditions, and it is quite likely that sugar beet may next year be free from a pest whose extraordinary abundance in 1938 made it seek crops other than those most natural to it—plants of the bean tribe. Indeed, since the whole beet crop is removed, it is difficult to see where the infestation next year is to come from unless from neighbouring bean crops or unless there are euonymus trees close at hand. These "spindle trees" are known to be used by the bean aphis for egg-laying, and their removal might be considered.

The bean aphis is especially one that needs to be tackled on its first appearance, for its increase is so rapid and badly attacked leaves become so curled that treatment at an advanced stage is almost hopeless. In the few cases where dusting or spraying was resorted to in the recent outbreak the results were not very encouraging. The chief point which emerges is that sugar-beet crops must be examined next June for signs of the first appearance of the aphis, so that no time may be lost in applying remedies.

Allotments and vegetable gardens were this year on the whole remarkably free from the usual late-summer and autumn pests. Celery-fly, so prevalent last year, was practically absent. The cabbage butterflies were abundant in some districts but in others much less destructive than usual. One insect pest—the cabbage white-fly (*Aleurodes brassicæ*)—appears to be on the increase and has done considerable injury to some vegetables, especially sprouts.

Fruit Crops.

It was in this section that the spring weather was most disastrous, many crops being complete failures from this cause

alone, so that not much interest attaches to the insect pests which added to the general loss.

Among the numerous species of aphis those brought most frequently to my notice were woolly aphis on apple and the black aphis (*Myzus cerasi*) on cherry trees. Other pests reported were magpie moth and sawfly on gooseberries, and a case of plum tree injury by the bark beetle *Scolytus rugosus*.

The treatment by dusting and spraying with derris compounds has been found so effective in controlling the raspberry beetle that this pest, which formerly did very great injury to raspberries, loganberries and cultivated blackberries, is now seldom complained of.

Glass House Pests.

In April I received word from a Member that his tomato and cucumber plants, under glass, were in a very unsatisfactory state, a characteristic being a multitude of white spots on the foliage. I visited the houses and made a thorough examination. The cucumber plants seemed healthy enough, and though there were many white spots on the leaves I diagnosed these as sun-scorch. It was otherwise in the tomato house, where the plants were obviously failing. Three different insect pests were present—in small numbers—on the tomato plants, an aphis, white-fly (*Aleurodes*) and thrips. The white markings on the leaves were evidently the work of thrips, though extremely few examples of the insect were found.

I was not at all satisfied that the very bad condition of the tomato plants was fully accounted for by the work of these insects, the obvious damage done by them being comparatively slight. I remembered, however, that thrips is alleged to be the carrier of a virus disease which is fatal to tomato and various other plants, and I consulted Dr. Kenneth Smith, an authority on these diseases, and we visited the glass houses together. He found that most of the plants were infected by virus disease, for which no remedy is known.

It remained to find out, if possible, whence the disease had been carried by the thrips to the tomato house. It appears that this particular virus disease attacks a rather wide variety of plants—including arum lilies! Quite near the entrance to the tomato house was a clump of arum lilies clearly infected by the disease.

The case was serious, for the infected tomato plants were doomed, but there was some satisfaction that the trouble was at least traced to its origin. Very drastic treatment was necessary, but if the diseased plants were destroyed and if, as

an extra precaution, thrips was eradicated by fumigation, there was no reason why new tomato plants should not flourish in the houses.

A certain amount of "white-fly" (*Aleurodes*) had been observed on the tomato plants. This disease has in many cases been successfully treated by introducing a parasite, *Encarsia formosa*, into infested glass houses, and the parasite is reared in large numbers for this purpose. In the present case no such measure had been taken, but I was interested to find that many of the *Aleurodes*' scales were parasitised, and the parasite on breeding out proved to be *Encarsia formosa*. There was, therefore, little likelihood of trouble from that source.

Animal Parasites.

In April I received some ticks from sheep in N. Wales. The sender was engaged in an investigation of the disease of "joint evil" and its possible connection with tick infestation. The specimens did not belong to the species usually spoken of as the "sheep tick" (*I. ricinus*) but were examples of *H. punctata*, a species much less common in this country.

An application for advice with regard to "warble-fly" on horses was received from a stud farm in August. Further correspondence made it clear that the flies complained of were not warble-flies but belonged to the family Tabanidæ, commonly known as clegs, gad-flies, breeze-flies or horse-flies. These insects, though extremely annoying, have fortunately only a temporary effect, as they visit animals merely to suck their blood and not, as is the case with the warble- and bot-flies, to lay eggs on their hairs. As everyone has experienced, they also attack man, and meadows near woods are often swarming with common grey cleg *Hæmatopota pluvialis*.

No doubt their effect on the highly sensitive horses of a stud farm might be very deleterious. Any attempt to exterminate them seems hopeless, for their larval stage is passed underground or in water, but something might be done to protect valuable animals by the application of some deterrent dressing. I am not aware whether anything of this nature is practised by horse breeders, but I note that a French parasitologist, M. Brumpt, recommends the use of cade oil for this purpose. This oil, prepared from the Spanish juniper, appears to be particularly objectionable to gad-flies.

Miscellaneous Notes.

Several cases of insects infesting dwelling-houses were referred to me during the year. Two concerned the mysterious

Chloropisca, which is almost annually reported from somewhere. This minute fly—rather like a small edition of the "gout-fly" of barley, to which it is related—has the remarkable habit of swarming in the autumn and invading houses, recurring at intervals in the same houses and even in the same rooms. They do no harm, seeking only shelter, nor has any injury by them been noted in the grass land from which they come. There are particular rooms at Cambridge periodically infested by them, but the reason for their choice is entirely unknown. Dipterists have recently found reason to change the nomenclature of this fly which now rejoices in the name of *Thaumatomyia notata.*

A rarer case was the occurrence of the "raven-fly," *Musca corvina*, which appeared "in incredible numbers" in a loft of a country house. It is known occasionally to seek in this way shelter for hibernation, and it is quite harmless, having no designs upon food materials. Much more serious and more difficult to deal with are the cases of fleas infesting buildings in the neighbourhood of pig-styes. All fleas begin life in the form of grubs or larvæ which feed on filth, so that a pig-sty is an ideal breeding ground for any species of flea. As the human flea, *Pulex irritans*, also attacks the pig it is the species generally found, though cat, dog or hen fleas sometimes avail themselves of so suitable a breeding place. The buildings close at hand are the natural objectives of the fleas which come from the styes.

Several instances of insects infesting stored products were the subject of enquiry and some seem worth recording.

Some creatures found in marmalade were identified as the puparia (chrysalids) of a *Drosophila* fly. These flies are well known to be attracted by overripe and decaying fruit, and their presence indicated an unsatisfactory condition of the oranges from which the marmalade was made.

Two cases of trouble from the "bacon beetle" (*Dermestes lardarius*) were reported, but in another instance a different species of *Dermestes* was concerned—*D. vulpinus*. This was attacking sacks of whale-meat meal. The beetle is cosmopolitan and might have been acquired anywhere, but from the condition of the sacks it seemed evident that the meal when packed was quite free of the beetle, but that the sacks had been placed for a time in a beetle-infested hold or store-house.

Other insects attacking stored goods were *Fannia*, the "lesser house-fly," whose puparia were found in sausage skins, and *Sitodrepa panacea*, the "biscuit weevil," to which some damage to stationery was traced.

Beetles found on worm-eaten flooring proved to be *Corynetes cœruleus*—a species which is carnivorous and preys upon the wood-boring *Anobium*, whose presence was thus indirectly indicated.

A fully grown specimen of the goat-moth caterpillar, alleged to be turned up by ploughing, was sent for identification. This caterpillar, of course, lives in the trunks of trees, and was no doubt wandering over the surface of the field to find a safe place for pupating when it was caught by the plough.

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THE SOCIETY'S TRACTOR TESTING SCHEME.

FIFTEEN further tests have been carried out during the year under this Scheme. Six of these tests were of tractors deferred from the original entries and were carried out in March at two sites at Steventon and Sutton Courtenay, Berks., respectively. The remaining nine machines were new entries and were tested on the farm adjoining the Field Station of the Institute for Research in Agricultural Engineering at Long Wittenham, Berks., in September. Great difficulty has been experienced in selecting light and heavy land to correspond with the standards of ploughing resistance originally laid down; and in some instances the resistance of land has been found to have changed quite considerably between the time when it was chosen and the actual date of the tests. There is, however, no reason to doubt the accuracy of the method of converting the results of individual tests to standard conditions for purposes of comparison; while, since it is hoped that all future tests will be carried out at Long Wittenham, the difficulties of securing comparable conditions should be greatly reduced in the future.

The results of all tests are given in Tables I, II and III in precisely the same form as those recorded in the last *Journal*, where full details of the conditions of test were also given.

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LIST OF ENTRIES.

Official No.

11. "Caterpillar" Twenty-two Tracklaying tractor: 4-cylinder vertical engine starting on petrol, running on vaporizing oil; bore 4 in.; stroke 5 in; crankshaft speed 1250 r.p.m. Entered by Jack Olding & Co., Ltd., 101 Grosvenor Road, London, S.W.1, and H. Leverton & Co., Broad Street, Spalding, Lincs.

12. Massey-Harris "Challenger" Pneumatic-tyred Wheel tractor: 4-cylinder vertical engine starting on petrol, running on vaporizing oil; bore $3\frac{7}{8}$ in.; stroke $5\frac{1}{4}$ in.; crankshaft speed 1200 r.p.m. Entered by Massey-Harris Ltd., Ashburton Road, Trafford Park, Manchester.

Official No.

13. Case CC4 Pneumatic-tyred Wheel tractor: 4-cylinder vertical engine starting on petrol, running on vaporizing oil; bore $3\frac{7}{8}$ in.; stroke $5\frac{1}{2}$ in.; crankshaft speed 1100 r.p.m. Entered by Associated Manufacturers' Co. (London) Ltd., The Palace of Industry, Wembley, Middlesex.

14. Case CC4 Wheel tractor: 4-cylinder vertical engine starting on petrol, running on vaporizing oil; bore $3\frac{7}{8}$ in.; stroke $5\frac{1}{2}$ in.; crankshaft speed 1100 r.p.m. Entered by Associated Manufacturers' Co. (London) Ltd., The Palace of Industry, Wembley, Middlesex.

15. International Farmall F.20 Wheel tractor: 4-cylinder vertical engine starting on petrol, running on vaporizing oil; bore $3\frac{3}{4}$ in.; stroke 5 in.; crankshaft speed 1200 r.p.m. Entered by International Harvester Co., of Great Britain Ltd., 259 City Road, London, E.C.1.

16. John Deere Model BR Wheel tractor: 2-cylinder horizontal engine starting on petrol, running on vaporizing oil; bore $4\frac{1}{4}$ in.; stroke $5\frac{1}{4}$ in.; crankshaft speed 1150 r.p.m. Entered by F. A. Standen & Sons Ltd., Stanpoint Works, St. Ives, Hunts.

17. Fowler Four-Forty Diesel Tracklaying tractor: 4-cylinder vertical compression-ignition engine starting by hand, running on light diesel oil; bore $4\frac{1}{4}$ in.; stroke $6\frac{1}{4}$ in.; crankshaft speed 1100 r.p.m. Entered by John Fowler & Co., (Leeds) Ltd., Leeds.

18. Fowler Thirty-Five Diesel Tracklaying tractor: 3-cylinder vertical compression-ignition engine starting by hand, running on light diesel oil; bore $4\frac{1}{4}$ in.; stroke $6\frac{1}{4}$ in.; crankshaft speed 1350 r.p.m. Entered by John Fowler & Co., (Leeds) Ltd., Leeds.

19. "Caterpillar" Diesel D2 Tracklaying tractor: 4-cylinder vertical compression-ignition engine starting by independent 2-cylinder petrol engine, running on light diesel oil; bore $3\frac{3}{4}$ in.; stroke 5 in.; crankshaft speed 1525 r.p.m. Entered by Jack Olding & Co., Ltd., 101 Grosvenor Road, London, S.W.1, and H.Leverton & Co., Broad Street, Spalding, Lincs.

20. Fowler Twenty-Five Diesel Tracklaying tractor: 3-cylinder vertical compression-ignition engine, starting by hand, running on light diesel oil; bore $4\frac{1}{4}$ in.; stroke $6\frac{1}{4}$ in.; crankshaft speed 1100 r.p.m. Entered by John Fowler & Co. (Leeds) Ltd., Leeds.

TABLE

Official Number of Tractor.	Name of Tractor.	Fuel Used.	Nominal Weight. Lb.	Nominal Speeds. 1st M.P.H.	2nd M.P.H.	2rd M.P.H.	Max. Ploughing on Firm: Gear.	Mean Speed. M.P.H.	Ratio. Actual Speed. / Nom. Speed %.
11	Caterpillar 22	T.V.O. ..	6,210	2·00	2·60	3·60	1	1·92	96
12	Massey-Harris Challenger	T.V.O. ..	4,455	2·40	3·30 (+ 8·50)	4·10	2	2·90	88
13	Case C.C.4 Pneumatic ..	T.V.O. ..	4,000	2·33	3·33	4·50	2	3·06	92
14	Case C.C.4 Steel Wheel..	T.V.O. ..	3,920	2·56	3·66	4·95	1	2·49	97
15	I. H. C. Farmall, F.20 ..	T.V.O. ..	3,780	2·39	3·29 (+ 4·48)	3·88	2	3·08	94
16	John Deere, B.	T.V.O. ..	2,763	2·56	3·30 (+ 5·50)	4·40	1	2·60	102
17	Fowler, 4–40	Diesoline..	10,100	1·81	2·57	3·54	2	2·54	98
18	Fowler, 35	Diesoline..	8,750	2·22	3·15	4·34	1	2·25	101
19	Caterpillar, D.2 ..	Diesoline..	6,400	1·70	2·50 (+ 3·60 & 5·10)	3·00	2	2·31	92
20	Fowler, 25	Diesoline..	7,960	1·81	2·57	3·54	2	2·43	95
21	Marshall, M.	Diesoline..	5,300	2·20	3·10	5·00	2	2·63	85
22	Allis-Chalmers, M. ..	T.V.O. ..	6,650	1·83	2·23 (+ 4·15)	3·20	2	2·27	102
23	Oliver, 80	T.V.O. ..	4,150	3·04	3·74	4·84	2	3·25	87
24	Allis-Chalmers, U. ..	T.V.O. ..	4,400	2·89	3·76 (+ 12·42)	5·20	2	3·51	93
25	Allis-Chalmers, W. F. ..	T.V.O. ..	3,800	2·50	3·50 (+ 10·00)	4·75	2	3·00	86

Notes on Table I.

(1) In the case of the steel-wheeled tractors (Nos. 14, 15, 16, 23 and 24) the nominal

(2) The maximum horse-power ploughing tests of the I.H.C. Farmall F.20, medium loam). With these exceptions all the above tests were carried out on heavy

(3) In the case of the Diesel tractors (Nos. 17, 18, 19, 20 and 21) the dilution

Notes on Table II.

(1) The standard heavy-land conditions referred to in the Table are: Average depth

Notes on Table III.

(1) The standard light-land conditions referred to in the Table are: Average depth

I.

Horse-Power Stubble.			Maximum Pull, 1st Gear on Firm Ground.	Power Developed in Cultivating Rough Loose Fallow.					Oil Dilution.			
Mean Draw-bar Pull.	H.P.	Wheel or Track Slip.		Gear.	Mean Speed.	Mean Pull.	H.P.	Slip.	Grade of Oil Used.	After 8 Hours Running at Full Load.	Over Full Period of Test at Various Loads.	
											Approx. Running Time.	Dilution.
Lb.		%	Lb.		M.P.H.	Lb.		%		Dilution %	Hours.	%
4,150	**23·1**	6·0	**5,250**	2	**2·38**	3,400	**21·6**	5·6	Mobiloil A..	9·8	17¾	14·4
2,850	**22·0**	19·7	**4,250**	2	**3·18**	1,750	**14·9**	19·3	Double Shell	12·3	17½	14·8
2,490	**20·3**	16·4	**3,700**	2	**2·90**	1,800	**13·9**	19·5	Price's Motorine C	9·6	15¼	11·8
2,930	**19·4**	6·2	**3,600**	2	**2·95**	1,850	**14·5**	13·6	Price's Motorine C	9·4	18½	11·6
2,060	**16·9**	4·7	**3,600**	2	**3·21**	1,600	**13·7**	8·4	Mobiloil A..	10·0	16	15·9
1,460	**10·1**	5·2	**2,100**	2	**3·63**	950	**9·2**	7·8	Triple Shell	5·9	20¼	6·9
4,170	**28·2**	3·6	**8,250**	2	**2·35**	3,900	**24·4**	3·7	Shell Dervoil	—	17¼	—
4,280	**25·7**	0·6	**6,600**	1	**2·21**	3,580	**21·1**	3·2	Shell Dervoil	—	16½	—
3,710	**22·9**	4·0	**6,300**	2	**2·18**	3,470	**20·2**	4·5	Shell Ardol	—	17¼	—
3,240	**21·0**	4·7	**6,300**	2	**2·07**	3,500	**19·3**	0·6	Shell Dervoil	—	16¾	—
2,070	**14·5**	15·9	**4,350**	2	**2·27**	2,310	**14·0**	19·8	Raines & Porter Velvol	—	18¼	—
4,280	**25·9**	6·2	**5,750**	2	**2·18**	3,950	**23·0**	11·0	Triple Shell	8·4	16¾	9·6
2,550	**22·1**	14·6	**4,750**	2	**3·04**	1,500	**12·2**	19·2	Mobiloil A..	12·0	16¾	16·8
2,310	**21·6**	10·2	**4,000**	2	**3·22**	1,520	**13·0**	14·6	Triple Shell	8·8	16½	13·4
1,900	**15·2**	15·8	**3,000**	2	**3·33**	1,410	**12·5**	11·2	Triple Shell	10·4	16	14·0

speeds given in this report refer to the tractor when fitted with wheel lugs as used in the tests.
Fowler 25, and Allis-Chalmers U. (Nos. 15, 20 and 24) were carried out on light land (light-
land (Kimmeridge and Gault Clay).
of the lubricating oil was not recorded.

of ploughing, 5·5 inches; Mean resistance of land, 14 lb. per square inch of furrow section.

of ploughing, 5 inches; Mean resistance of land, 7·5 lb. per square inch of furrow section.

TABLE II.

(1) March 1938.—Tumble-down Grass on Kimmeridge Clay.

8-Hours Ploughing Test on Heavy Land.

Official Number of Tractor.	Name of Tractor.	Gear.	Plough Used.	Mean Furrow Dimensions. Width. In.	Depth. In.	Length. Chains.	Mean Speed. M.P.H.	Mean Pull. Lb.	Mean H.P.	Ratio % Actual H.P. / Max. H.P.	Fuel Consumption, Lbs. per H.P. Hour.	Mean Resistance of Land. Lb./Sq. In.	Acreage Ploughed and Fuel per Acre. As Recorded. Acres Ploughed per Hour.	As Recorded. Fuel per Acre Galls.	Corrected to Standard Conditions. Acres Ploughed per Hour	Corrected to Standard Conditions. Fuel per Acre Galls.
11	Caterpillar, 22 ..	1	Ransome Multitrac 4-Furrow	10·5	5·1	12·4	1·98	3,810	20·1	87·0	1·01	17·8	0·72	3·38	0·85	2·86
12	Massey-Harris Challenger	2	Massey-Harris 3-Furrow	9·5	4·6	11·2	3·10	2,520	20·8	94·5	0·97	19·2	0·69	3·51	0·79	3·07
13	Case C.C.4 Pneumatic	2	Ransome R.S.L.D. 2-Furrow	9·0	6·1	13·4	3·25	2,040	17·7	87·2	0·86	18·6	0·56	3·26	0·82	2·23
14	Case C.C.4 Steel Wheel	1	Ransome R.S.L.M. 3-Furrow	9·0	5·3	11·6	2·43	2,790	18·1	93·3	0·87	19·5	0·67	2·84	0·90	2·11
15	I. H. C. Farmall, F.20	1	I.H.C 3-Furrow	9·5	5·6	13·1	2·14	2,750	15·7	94·0	1·06	17·2	0·60	3·35	0·75	2·68
16	John Deere, B. ..	1	Ransome R.S.L.D. 2-Furrow	9·0	4·2	11·9	2·37	1,470	9·3	92·1	1·10	19·4	0·42	2·91	0·44	2·78

TABLE II (*continued*).

(2) September 1938.—Wheat Stubble on Clay Loam overlying Gault Clay.

8-HOURS PLOUGHING TEST ON HEAVY LAND.

Official Number of Tractor.	Name of Tractor.	Gear.	Plough Used.	Mean Furrow Dimensions. Width. In.	Depth. In.	Length. Chains.	Mean Speed. M.P.H.	Mean Pull. Lb.	Mean H.P.	Ratio % Actual H.P. / Max. H.P.	Fuel Consumption, Lbs. per H.P. Hour.	Mean Resistance of Land. Lb./Sq. In.	Acreage Ploughed and Fuel per Acre. As Recorded. Acres Ploughed per Hour.	As Recorded. Fuel per Acre Galls.	Corrected to Standard Conditions. Acres Ploughed per Hour	Corrected to Standard Conditions. Fuel per Acre Galls.
17	Fowler, 4–40 ..	2	Ransome Hexatrac 6-Furrow	9·5	6·4	7·9	2·55	3,850	26·2	92·9	0·54	10·6	1·20	1·41	1·05	1·61
18	Fowler, 35	1	Ransome Hexatrac 6-Furrow	9·5	6·2	8·0	2·29	3,410	20·8	81·0	0·61	9·6	1·14	1·34	0·88	1·73
19	Caterpillar, D.2 ..	2	Ransome Multitrac 4-Furrow	9·5	5·8	6·6	2·37	3,080	19·5	85·2	0·64	14·0	0·78	1·93	0·82	1·84
20	Fowler, 25	2	Ransome Quintrac 5-Furrow	9·5	5·6	7·6	2·51	2,720	18·2	86·7	0·67	10·2	1·02	1·42	0·76	1·91
21	Marshall, M.	2	Ransome Multitrac 4-Furrow	9·5	5·4	11·8	2·72	1,900	13·8	95·2	0·72	9·3	0·95	1·24	0·62	1·91
22	Allis-Chalmers, M. ..	2	Ransome Quintrac 5-Furrow	9·5	6·3	9·1	2·37	3,380	21·4	82·6	0·79	11·3	1·02	1·97	0·94	2·13
23	Oliver, 80	2	Oliver 4-Furrow	10·0	6·3	11·4	3·41	2,340	21·3	96·4	1·00	9·3	1·35	1·88	1·03	2·47
24	Allis-Chalmers, U. ..	2	Ransome Multitrac 3-Furrow	9·5	6·0	9·5	3·54	1,760	16·6	76·8	1·30	10·3	0·89	2·90	0·71	3·62
25	Allis-Chalmers, W. F.	2	Ransome R.S.L.D. 2-Furrow	9·0	5·8	8·3	3·11	1,290	10·7	70·4	1·30	12·4	0·56	2·98	0·52	3·20

TABLE III.

(1) March 1938.—Barley Stubble on Light-medium Loam overlying Gravel.

Official Number of Tractor.	Name of Tractor.	8-Hours Ploughing Test on Light Land.															
		Gear.	Plough Used.	Mean Furrow Dimensions.			Mean Speed.	Mean Pull.	Mean H.P.	Ratio % Actual H.P. / Max. H.P.	Fuel Consumption, Lbs. per H.P. Hour.	Mean Resistance of Land.	Acreage Ploughed and Fuel per Acre.			
				Width.	Depth.	Length.							As Recorded.		Corrected to Standard Conditions.	
				In.	In.	Chains.	M.P.H.	Lb.				Lb./Sq. In.	Acres Ploughed per Hour.	Fuel per Acre Galls.	Acres Ploughed per Hour	Fuel per Acre Galls.
11	Caterpillar, 22 . .	2	Ransome Quintrac 5-Furrow	10·5	4·6	9·4	2·55	2,790	19·0	92·2	0·97	11·6	1·16	1·90	1·65	1·34
12	Massey-Harris Challenger	2	Ransome Motrac-Major 4-Furrow	9·0	5·1	13·4	3·28	2,090	18·3	83·2	0·83	11·4	1·10	1·65	1·71	1·06
13	Case C.C.4 Pneumatic	2	Ransome Motrac-Major 4-Furrow	9·0	5·2	12·6	3·15	2,110	17·7	87·2	0·82	11·3	1·06	1·65	1·66	1·05
14	Case C.C.4 Steel Wheel	2	Massey-Harris 3-Furrow	9·5	5·0	11·4	3·36	1,750	15·7	79·3	0·90	12·3	0·89	1·90	1·46	1·16
15	I. H. C. Farmall, F.20	2	I.H.C. 4-Furrow	9·5	4·9	10·8	3·05	1,930	15·7	92·9	1·12	10·4	1·03	2·04	1·40	1·50
16	John Deere, B. . .	2	Ransome R.S.L.D. 2-Furrow	9·0	4·8	12·0	3·43	1,040	9·5	96·0	1·22	12·0	0·65	2·14	1·00	1·39

TABLE III (*continued*).

(2) SEPTEMBER 1938.—WHEAT, BARLEY AND FLAX STUBBLES ON GRAVELLY LOAM OVERLYING RIVER GRAVEL.

8-HOURS PLOUGHING TEST ON LIGHT LAND.

Official Number of Tractor.	Name of Tractor.	Gear.	Plough Used.	Mean Furrow Dimensions. Width. In.	Depth. In.	Length. Chains.	Mean Speed. M.P.H.	Mean Pull. Lb.	Mean H.P.	Ratio % Actual H.P. / Max. H.P.	Fuel Consumption, Lbs. per H.P. Hour.	Mean Resistance of Land. Lb./Sq. In.	Acreage Ploughed and Fuel per Acre. As Recorded. Acres Ploughed per Hour.	Fuel per Acre Galls.	Corrected to Standard Conditions. Acres Ploughed per Hour	Fuel per Acre Galls.
17	Fowler, 4-40	2	Ransome 6-Furrow & 5-Furrow in Tandem	9·5	4·8	27·4	2·54	3,990	27·0	95·8	0·60	8·0	2·75	0·70	2·80	0·69
18	Fowler, 35	1	Ransome 5-Furrow & 3-Furrow in Tandem	9·5	5·5	21·8	2·26	3,910	23·6	91·8	0·59	9·4	1·72	0·97	2·36	0·71
19	Caterpillar, D.2 ..	3	Ransome Quintrac 5-Furrow	9·5	5·2	8·9	2·92	2,450	19·1	92·3	0·64	9·9	1·21	1·21	1·67	0·88
20	Fowler, 25	2	Ransome Quintrac 5-Furrow	9·5	5·9	16·0	2·55	2,720	18·5	88·1	0·65	9·7	1·12	1·29	1·71	0·84
21	Marshall, M.	2	Ransome Motrac-Major 4-Furrow	9·0	5·5	8·4	2·75	1,760	12·0	90·0	0·68	8·9	0·94	1·10	1·22	0·84
22	Allis-Chalmers, M. ..	3	Ransome Quintrac 5-Furrow	9·5	4·0	27·2	3·56	1,790	17·0	77·6	1·07	9·4	1·62	1·35	1·63	1·34
23	Oliver, 80	2	Oliver 5-Furrow	10·0	5·0	25·2	3·43	2,220	20·3	91·8	1·07	8·9	1·80	1·44	2·13	1·22
24	Allis-Chalmers, U. ..	2	Ransome Quintrac 5-Furrow	9·5	5·1	8·7	3·53	2,200	20·7	95·8	1·28	9·1	1·40	2·26	1·73	1·83
25	Allis-Chalmers, W.F.	2	Ransome Multitrac 3-Furrow	9·5	5·7	7·7	3·18	1,450	12·3	80·9	1·07	8·9	0·88	1·80	1·19	1·33

Official No.

21. Marshall Model M Diesel Pneumatic-tyred Wheel tractor: 1-cylinder horizontal 2-stroke compression-ignition engine starting by hand with cartridge, running on light diesel oil; bore $6\frac{1}{2}$ in.; stroke 9 in.; crankshaft speed 700 r.p.m. Entered by Marshall & Sons (Successors) Ltd., Britannia Ironworks, Gainsborough.

22. Allis-Chalmers Model M Tracklaying tractor: 4-cylinder vertical engine starting on petrol, running on vaporizing oil; bore $4\frac{1}{2}$ in.; stroke 5 in.; crankshaft speed 1200 r.p.m. Entered by Allis-Chalmers Manufacturing Co., 728 Salisbury House, London Wall, London, E.C.2.

23. Oliver 80 Wheel tractor: 4-cylinder vertical engine starting on petrol, running on vaporizing oil; bore $4\frac{1}{2}$ in.; stroke $5\frac{1}{4}$ in.; crankshaft speed 1200 r.p.m. Entered by John Wallace & Sons Ltd., Hendon Aerodrome, Hendon, N.W.9.

24. Allis-Chalmers Model U Wheel tractor: 4-cylinder vertical engine starting on petrol, running on vaporizing oil; bore $4\frac{1}{2}$ in.; stroke 5 in.; crankshaft speed 1200 r.p.m. Entered by Allis-Chalmers Manufacturing Co., 728 Salisbury House, London Wall, London, E.C.2.

25. Allis-Chalmers Model WF. Pneumatic-tyred Wheel tractor: 4-cylinder vertical engine starting on petrol running on vaporizing oil; bore 4 in.; stroke 4 in.; crankshaft speed 1300 r.p.m. Entered by Allis-Chalmers Manufacturing Co., 728 Salisbury House, London Wall, London, E.C.2.

Royal Agricultural Society of England.

(Established May 9th, 1838, *as the* English Agricultural Society, *and incorporated by Royal Charter on March 26th,* 1840.)

Patron and President.

HIS MOST GRACIOUS MAJESTY THE KING.

Deputy President for 1939.

THE EARL OF ATHLONE, K.G.

Year when first elected on Council	
	Trustees.
1930	H.R.H. The Duke of Gloucester, K.G., *York House, St. James's Palace, S.W.*1.
1935	H.R.H. The Duke of Kent, K.G., 3, *Belgrave Square, S.W.*1.
1905	Adeane, Charles, C.B., *Babraham Hall, Cambridge.*
1895	Bedford, Duke of, K.G., *Woburn Abbey, Bedfordshire.*
1921	Burrell, Sir Merrik R., Bt., C.B.E., *Floodgates, West Grinstead.*
1887	Crutchley, Percy, *Sunninghill Lodge, Ascot, Berkshire.*
1924	Desborough, Lord, K.G., *Taplow Court, Maidenhead.*
1900	Greaves, R. M., *Wern, Portmadoc, North Wales.*
1909	Hazlerigg, Sir Arthur, Bt., *Noseley Hall, Leicestershire.*
1922	Mildmay of Flete, Lord, *Flete, Ivybridge, Devon.*
1914	Powis, Earl of, *Powis Castle, Welshpool, Mont.*
	Vice-Presidents.
1918	Burke, U. Roland, *Edensor House, Bakewell, Derbyshire.*
1921	Courthope, Col. The Right Hon. Sir G. L., Bt., M.C., M.P., *Whiligh, Sussex.*
1908	Derby, Earl of, K.G., *Knowsley, Prescot, Lancashire.*
1913	Evens, John, *Burton, Lincoln.*
1929	Harewood, Earl of, K.G., *Harewood House, Leeds.*
1905	Harris, Joseph, *Brackenburgh Tower, Penrith, Cumberland.*
1903	Harrison, William, *Albion Iron Works, Leigh, Lancashire.*
1911-17, 1926	Hastings, Lord, *Melton Constable Park, Norfolk.*
1937	Plymouth, Earl of, *St. Fagan's Castle, Cardiff.*
1915	Portland, Duke of, K.G., *Welbeck Abbey, Worksop, Notts.*
1907	Smith, Fred, *Deben Haugh, Woodbridge, Suffolk.*
1934	Stradbroke, Earl of, K.C.M.G., *Henham Hall, Wangford, Beccles.*
	Ordinary Members of the Council.
1922	Alexander, Hubert, *The Croft, Sully, Penarth* (*Glamorgan*).
1937	Baird, Capt. W. J., *Deanscroft, Oakham, Rutland* (*Rutland*).
1931	Barclay, E. E., *Brent Pelham Hall, Buntingford* (*Hertfordshire*).
1937	Belcher, J. Morris, *Tibberton Manor, Wellington* (*Shropshire*).
1922	Bell, John, *The Hall, Thirsk, Yorks.* (*London*).
1930	Benyon, Henry A., *Englefield House, near Reading* (*Berkshire*).
1921-29, 1935	*Bledisloe, Viscount, G.C.M.G., K.B.E., *Lydney Park, Glos.*
1936	Bourne, John, *Snowshill Hill, Moreton-in-Marsh* (*Gloucestershire*).
1934	Bruford, Robert, *Fons George House, Taunton* (*Somerset*).
1931	Burrell, Walter R., *Knepp Castle, Horsham* (*Sussex*).
1936	Cator, Capt. H. J., M.C., *Ranworth Hall, Norwich* (*Norfolk*).
1928	Christy, Capt. Hugh A., *Llangoed, Llyswen, Breconshire* (*S. Wales*).
1938	Cranworth, Lord, M.C., *Grundisburgh Hall, Woodbridge* (*Suffolk*).
1938	Cullimore, Charles, *Christleton, Chester* (*Cheshire*).

* Nominated Member of Council.

Year when first elected on Council	Ordinary Members of the Council—(*continued*).
1921	*Dampier, Sir W. C. D., Sc.D., F.R.S., *Upwater Lodge, Cambridge.*
1935	Digby, Lord, D.S.O., M.C., *Minterne, Dorchester (Dorset).*
1927	Dugdale, Major W. Marshall, D.S.O., *Llwyn, Llanfyllin, Mont. (North Wales).*
1935	Dyott, Major R. A., *The Manor of Freeford, Lichfield (Staffordshire).*
1936	Egerton, Lt.-Commdr. H. Sydney, D.S.C., R.N., *Mountfield Court, Robertsbridge (Sussex).*
1929	Elgin, Earl of, K.T., *Broomhall, Dunfermline (Scotland).*
1922	Eltisley, Lord, K.B.E., *Croxton Park, St. Neots (Huntingdonshire).*
1936	*Evans, Richard H., *Barclays Bank Chambers, Pwllheli.*
1936	Everall, Wm., *Berwick Mount, Shrewsbury (Shropshire).*
1924	Everard, Sir W. Lindsay, M.P., *Ratcliffe Hall, Leicester (Leicestershire).*
1933	Everett, Major Norman, *Rushmere, Ipswich (Suffolk).*
1928	Forshaw, Thomas, *The Stud, Carlton-on-Trent, Newark (Notts.).*
1935	Foster, Major Gordon B., *Leysthorpe, Oswaldkirk, York (Yorks., N. Riding).*
1922	Gates, B. J., *Pembury, Tring (Buckinghamshire).*
1916	Gilbey, Sir Walter, Bt., 18, *Orchard Court, Portman Square, W.1 (Essex)*
1931	Glossop, C. W. H., *Bramwith Hall, near Doncaster (Yorks., W. Riding).*
1925	Hale, Windham E., *Mowbreck Hall, Kirkham (Lancashire).*
1930	Hansford, Major C. C., *The Grove, Bristol,* 1 *(Gloucestershire).*
1939	Harris, John Frederick, *Bowscar, Penrith (Cumberland).*
1919	Hobbs, Robert, *Kelmscott, Lechlade, Glos. (Oxfordshire).*
1931	Jervoise, Major F. H. T., *Herriard Park, Basingstoke (Hampshire).*
1923	Johnstone, Capt. G. H., *Trewithen, Grampound Road (Cornwall).*
1932	Kilpatrick, James, *Craigie Mains, Kilmarnock (Scotland).*
1928	Matthews, R. Borlase, *Greater Felcourt, East Grinstead (Surrey).*
1927	*Neame, Thomas, *The Offices, Macknade, Faversham.*
1932	*Nicholson, A. C., *Trent Ironworks, Newark, Notts.*
1938	Osmond, Leslie K., *Barnoldby Hall, Barnoldby-le-Beck, Grimsby (Lincoln).*
1930	Quested, J. Egerton, *The Firs, Cheriton, Folkestone (Kent).*
1928	Radnor, Earl of, *Longford Castle, Salisbury (Wiltshire).*
1924	*Ransome, Edward C., *Highwood, Ipswich.*
1935	Robertson, William, *Stamford, Alnwick (Northumberland).*
1937	Robinson, J. C. E., F.S.I., 15a, *St. Paul's Square, Bedford (Bedfordshire).*
1927	*Russell, Sir John, O.B.E., D.Sc., F.R.S., *Rothamsted Experimental Station, Harpenden, Herts.*
1931	Shelley, Sir John F., Bt., *Shobrooke Park, Crediton (Devonshire).*
1934	Smith, William, *The Leen, Pembridge, Leominster (Herefordshire).*
1933	Stedman, Sir L. Foster, *The Garth, Bassaleg, Newport (Monmouthshire).*
1938	Stopford Sackville, N. V., *Drayton House, Lowick, Kettering (Northamptonshire).*
1929	Strafford, Earl of, *Wrotham Park, Barnet (Middlesex).*
1938	Talbot-Ponsonby, A. H. B., *Hinton Woodlands, Bramdean, Alresford (Hampshire).*
1924	Wakefield, Jacob, *Sedgwick House, Kendal (Westmorland).*
1933	Walker, Sir Ian, Bt., *Osmaston Manor, Derby (Derbyshire).*
1933	Walker, John, *Knightwick Manor, Worcester (Worcestershire).*
1929	Webb, S. Owen, *Streetly Hall, West Wickham (Cambridgeshire).*
1925	Weigall, Lt.-Col. Sir Archibald G., Bt., K.C.M.G., *Englemere, Ascot (London).*
1936	Weightman, Albert, *Middle Herrington Farm, Sunderland (Durham).*
1931	Wheatley, Col. C. J. H., *Berkswell Hall, Coventry (Warwickshire).*
1918	Wickham-Boynton, T. L., *Burton Agnes Hall, Driffield (Yorks., E. Riding).*
1938	Wiglesworth, R. T., *Rangemore, Rostherne, Knutsford (Cheshire).*
1938	Wright, R. K., *Kilkea, Mageney, Co. Kildare (Ireland).*

* Nominated Member of Council.

STANDING COMMITTEES.

*** Under Bye-Law 73, the President is a Member *ex officio* of all Committees, and the Trustees and Vice-Presidents are Members *ex officio* of all Standing Committees except the Committee of Selection and General Purposes.

Finance Committee.

Adeane, C. (*Chairman*)	Alexander, H.	Greaves, R. M.
Radnor, Earl of	Bell, John	Harrison, W.
Burrell, Sir Merrik	Bruford, R.	Wheatley, Col.
Courthope, Sir G. L.	Burke, U. Roland	
Hazlerigg, Sir A.	Crutchley, Percy	
Stedman, Sir L. F.	Glossop, C. W. H.	

Journal and Education Committee.

Neame, T. (*Chairman*)	Hazlerigg, Sir A.	Dugdale, Major W. M.
Elgin, Earl of	Russell, Sir John	Glossop, C. W. H.
Radnor, Earl of	Adeane, C.	Hansford, Major C. C.
Burrell, Sir Merrik	Burke, U. Roland	
Dampier, Sir W. C. D.	Burrell, Walter R.	

Chemical Committee.

Gates, B. J. (*Chairman*)	Bruford, Robert	Jervoise, Major F. H. T.
Bledisloe, Viscount	Everett, Major N.	Quested, J. E.
Dampier, Sir W. C. D.	Greaves, R. M.	Robertson, W.
Russell, Sir John	Hale, W. E.	Smith, Fred

Botanical and Zoological (Forestry and Orchards) Committee.

Hastings, Lord (*Chairman*)	Christie, Capt. H. A.	Savill, Eric H.
Courthope, Sir G. L.	Dugdale, Major W. M.	Talbot-Ponsonby, A. H. B.
Hazlerigg, Sir A.	Gardner, R. C. B.	Thompson, C. H.
Benyon, H. A.	Hansford, Major C. C.	Walker, John
Bourne, John	Henderson J. K.	Weetman, Col. W. C. C.
Burke, U. Roland	Jervoise, Major F. H. T.	
Burrell, Walter R.	Le Sueur, A. D. C.	
	Neame, T.	

Veterinary Committee.

Burrell, Sir Merrik (*Chairman*)	Bell, John	Harris, Joseph
Radnor, Earl of	Burke, U. Roland	Johnstone, Capt. G. H.
Digby, Lord	Burrell, Walter R.	Quested, J. E.
Mildmay of Flete, Lord	Buxton, Prof. J. Basil	Robertson, W.
Gilbey, Sir Walter	Crutchley, Percy	Smith, Fred
Shelley, Sir J. F.	Dugdale, Major W. M.	Smith, William
Stedman, Sir L. F.	Foster, Major G. B.	Walker, John
Weigall, Sir A. G.	Gates, B. J.	Weightman, A.
Barclay, E. E.	Glossop, C. W. H.	Wheatley, Col.
	Harris, J. F.	

Committee of Selection and General Purposes.

THE PRESIDENT (*Chairman*)
MILDMAY OF FLETE, Lord
COURTHOPE, Sir G. L.
WEIGALL, Sir A. G.
CRUTCHLEY, PERCY
SMITH, FRED

And the Chairman of each of the Standing Committees.

Research Committee.

DAMPIER, Sir W. C. D. (*Chairman*)
RADNOR, Earl of
BLEDISLOE, Viscount
CRANWORTH, Lord
HASTINGS, Lord
BURRELL, Sir MERRIK
RUSSELL, Sir JOHN
ADEANE, C.
BURKE, U. ROLAND
BURRELL, WALTER R.
CATOR, Capt. H. J.
CULLIMORE, C.
DUGDALE, Major W. M.
DYOTT, Major R. A.
HANSFORD, Major C. C.
MATTHEWS, R. B.
NEAME, T.
SMITH, FRED
WIGAN, Capt. D. G.

Stock Prizes Committee.

FOSTER, Major G. B. (*Chairman*)
CRANWORTH, Lord
DIGBY, Lord
BURRELL, Sir MERRIK
STEDMAN, Sir L. F.
WALKER, Sir IAN
WEIGALL, Sir A. G.
ALEXANDER, H.
BARCLAY, E. E.
BELCHER, J. MORRIS
BELL, JOHN
BURKE, U. ROLAND
CRUTCHLEY, PERCY
EVANS, R. H.
EVENS, JOHN
EVERALL, W.
EVERARD, Sir LINDSAY
EVERETT, Major N.
FORSHAW, T.
GLOSSOP, C. W. H.
GREAVES, R. M.
HARRIS, JOSEPH
HOBBS, ROBERT
KILPATRICK, JAMES
OSMOND, L. K.
QUESTED, J. E.
ROBERTSON, W.
SMITH, FRED
SMITH, WILLIAM
WALKER, JOHN
WEBB, S. OWEN
WEIGHTMAN, A.
WICKHAM-BOYNTON, T. L.
The Stewards of Live Stock

Judges Selection Committee.—*Same as Stock Prizes Committee.*

Implement Committee.

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COURTHOPE, Sir G. L.
DAMPIER, Sir W. C. D.
STEDMAN, Sir L. F.
BRUFORD, R.
BURKE, U. ROLAND
CATOR, Capt. H. J.
CRUTCHLEY, PERCY
DYOTT, Major R. A.
EVENS, JOHN
EVERETT, Major N.
HARRISON, W.
MATTHEWS, R. B.
NICHOLSON, A. C.
OSMOND, L. K.
RANSOME, E. C.
ROBERTSON, W.
SAMPLE, C. H.
WEBB, S. OWEN
The Steward of Implements

Showyard Works Committee.

BURKE, U. ROLAND (*Chairman*)
BURRELL, Sir MERRIK
HAZLERIGG, Sir A.
STEDMAN, Sir L. F.
BELL, JOHN
BOURNE, JOHN
BRUFORD, R.
BURRELL, WALTER R.
CRUTCHLEY, PERCY
EVERETT, Major N.
FOSTER, Major G. B.
GLOSSOP, C. W. H.
HANSFORD, Major C. C.
NICHOLSON, A. C.
OSMOND, L. K.
TALBOT-PONSONBY, A. H. B.
WEBB, S. OWEN
WHEATLEY, Col.

Standing Committees.

Dairy and Produce Committee.

EVANS, RICHARD H. (*Chairman*)	BURKE, U. ROLAND	JOHNSTONE, Capt. G. H.
BURRELL, Sir MERRIK	CRUTCHLEY, PERCY	KAY, Dr. H. D.
DAMPIER, Sir W. C. D.	EVENS, JOHN	SMITH, FRED
WEIGALL, Sir A. G.	GLOSSOP, C. W. H.	
	GREAVES, R. M.	

Horticultural Committee.

HAZLERIGG, Sir A. (*Chairman*)	BURKE, U. ROLAND
HUNT, E. W.	SAVILL, ERIC H.

Honorary Director of Show.—U. ROLAND BURKE.

Surveyor to Show.—CHARLES H. R. NAYLOR, *St. Mary's Chambers, Queen Street, Derby.*

Society's Officers.

Secretary.—T. B. TURNER, 16 Bedford Square, London, W.C.1.

Editor of Journal.—Prof. J. A. SCOTT WATSON, *School of Rural Economy, Oxford.*

Consulting Chemist.—ERIC VOELCKER, A.R.C.S., F.I.C., 1 *Tudor Street, London, E.C.*4.

Consulting Veterinary Surgeon.—Prof. J. BASIL BUXTON, M.A., F.R.C.V.S., *Royal Veterinary College, Camden Town, London, N.W.*1.

Botanist.—Prof. Sir R. H. BIFFEN, F.R.S., *School of Agriculture, Cambridge.*

Zoologist.—CECIL WARBURTON, M.A., *School of Agriculture, Cambridge.*

Consulting Engineer.—S. J. WRIGHT, M.A., *Institute for Research in Agricultural Engineering,* 11 *Parks Road, Oxford.*

Publisher.—JOHN MURRAY, 50 *Albemarle Street, W.*1.

Solicitors.—GARRARD, WOLFE, GAZE & CLARKE, 18 *St. James's Place, S.W.*1.

Bankers.—WESTMINSTER BANK, LTD., 1 *St. James's Square, S.W.*1.

DISTRIBUTION OF GOVERNORS AND MEMBERS OF THE SOCIETY, AND OF ORDINARY MEMBERS OF THE COUNCIL.

Electoral District.	Division.	Number of Governors and Members.	Number of Ordinary Members of Council.	Ordinary Members of Council.
A.	Bedfordshire	52	1	J. C. E. Robinson.
	Cheshire	361	2	C. Cullimore; R. T. Wiglesworth.
	Cornwall	76	1	Capt. G. H. Johnstone.
	Derbyshire	211	1	Sir Ian Walker, Bt.
	Dorset	81	1	Col. Lord Digby.
	Hampshire and Channel Islands	309	2	Major F. H. T. Jervoise; A. H. B. Talbot-Ponsonby.
	Hertfordshire	168	1	E. E. Barclay.
	Lancashire and Isle of Man	237	1	Windham E. Hale.
	Middlesex	53	1	Earl of Strafford.
	Monmouthshire	73	1	Sir L. Foster Stedman.
	Norfolk	251	1	Capt. H. J. Cator.
	Northamptonshire	150	1	N. V. Stopford Sackville.
	Northumberland	215	1	William Robertson.
	Staffordshire	228	1	Major R. A. Dyott.
	Worcestershire	133	1	John Walker.
	Yorkshire, N.R.	185	1	Major Gordon B. Foster.
	Scotland	301	2	Earl of Elgin; James Kilpatrick.
		3,084	20	
B.	Buckinghamshire	110	1	B. J. Gates.
	Devon	153	1	Sir J. F. Shelley, Bt.
	Durham	116	1	Albert Weightman.
	Essex	259	1	Sir Walter Gilbey, Bt.
	Herefordshire	139	1	William Smith.
	Leicestershire	163	1	Sir W. Lindsay Everard.
	London	407	2	John Bell; Sir A. G. Weigall, Bt.
	Nottinghamshire	155	1	Thomas Forshaw.
	Rutland	42	1	Capt. W. J. Baird.
	Shropshire	327	2	J. Morris Belcher; William Everall.
	Suffolk	321	2	Lord Cranworth; Major Norman Everett.
	Surrey	178	1	R. Borlase Matthews.
	Wiltshire	147	1	Earl of Radnor.
	Yorkshire, W.R.	252	1	C. W. H. Glossop.
	South Wales	79	1	Capt. H. A. Christy.
		2,848	18	
C.	Berkshire	179	1	H. A. Benyon.
	Cambridgeshire	187	1	S. Owen Webb.
	Cumberland	117	1	John F. Harris.
	Glamorgan	130	1	Hubert Alexander.
	Gloucestershire	300	2	John Bourne; Major C. C. Hansford.
	Huntingdonshire	29	1	Lord Eltisley.
	Kent	255	1	J. E. Quested.
	Lincolnshire	244	1	Leslie K. Osmond.
	Oxfordshire	163	1	Robert Hobbs.
	Somerset	186	1	Robert Bruford.
	Sussex	331	2	Walter R. Burrell; Lieut.-Comdr. H. S. Egerton.
	Warwickshire	230	1	Col. C. J. H. Wheatley.
	Westmorland	66	1	Jacob Wakefield.
	Yorkshire, E.R.	86	1	T. L. Wickham-Boynton.
	Ireland	52	1	R. K. Wright.
	North Wales	173	1	Major W. Marshall Dugdale.
		2,728	18	
Foreign Countries		185		*Viscount Bledisloe.
				*Sir W. C. D. Dampier.
Members with no Addresses		20	7	*Richard H. Evans.
				*Thomas Neame.
Grand Totals		8,865	63	*A. C. Nicholson.
				*E. C. Ransome.
				*Sir John Russell.

* Nominated Members of Council.

Table showing the Number of GOVERNORS and MEMBERS in each Year from the Establishment of the Society.

Year.	President of the Year.	Governors.		Members.			Total.
		Life.	Annual.	Life.	Annual.	Honorary.	
1839	3rd Earl Spencer	—	—	—	—	—	1,100
1840	5th Duke of Richmond	86	189	146	2,434	5	2,860
1841	Mr. Philip Pusey	91	219	231	4,047	7	4,595
1842	Mr. Henry Handley	101	211	328	5,194	15	5,849
1843	4th Earl of Hardwicke	94	209	429	6,155	15	6,902
1844	3rd Earl Spencer	95	214	442	6,161	15	6,927
1845	5th Duke of Richmond	94	198	527	5,899	15	6,733
1846	1st Viscount Portman	92	201	554	6,105	19	6,971
1847	6th Earl of Egmont	91	195	607	5,478	20	6,391
1848	2nd Earl of Yarborough	93	186	648	5,387	21	6,335
1849	3rd Earl of Chichester	89	178	582	4,643	20	5,512
1850	4th Marquis of Downshire	90	169	627	4,356	19	5,261
1851	5th Duke of Richmond	91	162	674	4,175	19	5,121
1852	2nd Earl of Ducie	93	156	711	4,002	19	4,981
1853	2nd Lord Ashburton	90	147	739	3,928	19	4,923
1854	Mr. Philip Pusey	88	146	771	4,152	20	5,177
1855	Mr. William Miles, M.P.	89	141	795	3,838	19	4,882
1856	1st Viscount Portman	85	139	839	3,896	20	4,979
1857	Viscount Ossington	83	137	896	3,933	19	5,068
1858	6th Lord Berners	81	133	904	4,010	18	5,146
1859	7th Duke of Marlborough	78	130	927	4,008	18	5,161
1860	5th Lord Walsingham	72	119	927	4,047	18	5,183
1861	3rd Earl of Powis	84	90	1,113	3,328	18	4,633
1862	H.R.H. The Prince Consort 1st Viscount Portman	83	97	1,151	3,475	17	4,823
1863	Viscount Eversley	80	88	1,263	3,735	17	5,183
1864	2nd Lord Feversham	78	45	1,343	4,013	17	5,496
1865	Sir E. C. Kerrison, Bart, M.P.	79	81	1,386	4,190	16	5,752
1866	1st Lord Tredegar	79	84	1,395	4,049	15	5,622
1867	Mr. H. S. Thompson	77	82	1,388	3,903	15	5,465
1868	6th Duke of Richmond	75	74	1,409	3,888	15	5,461
1869	H.R.H. The Prince of Wales, K.G.	75	73	1,417	3,864	17	5,446
1870	7th Duke of Devonshire	74	74	1,511	3,764	15	5,436
1871	6th Lord Vernon	72	74	1,589	3,896	17	5,648
1872	Sir W. W. Wynn, Bart., M.P.	71	73	1,655	3,953	14	5,768
1873	3rd Earl Cathcart	74	62	1,832	3,936	12	5,916
1874	Mr. Edward Holland	76	58	1,944	3,756	12	5,846
1875	1st Viscount Bridport	79	79	2,058	3,918	11	6,145
1876	2nd Lord Chesham	83	78	2,164	4,013	11	6,349
1877	Lord Skelmersdale	81	76	2,239	4,073	17	6,486
1878	Col. Kingscote, C.B., M.P.	81	72	2,328	4,130	26	6,637
1879	H.R.H. The Prince of Wales, K.G.	81	72	2,453	4,700	26	7,332
1880	9th Duke of Bedford	83	70	2,673	5,083	20	7,929
1881	Mr. William Wells	85	69	2,765	5,041	19	7,979
1882	Mr. John Dent Dent	82	71	2,849	5,059	19	8,080
1883	6th Duke of Richmond and Gordon	78	71	2,979	4,952	19	8,099
1884	Sir Brandreth Gibbs	72	72	3,203	5,408	21	8,776
1885	Sir Massey Lopes, Bart., M.P.	71	69	3,356	5,619	20	9,135
1886	H.R.H. The Prince of Wales, K.G.	70	61	3,414	5,569	20	9,134
1887	2nd Lord Egerton of Tatton	71	64	3,440	5,387	20	8,982
1888	Sir M. W. Ridley, Bart., M.P.	66	56	3,521	5,225	16	8,884
1889	HER MAJESTY QUEEN VICTORIA	73	58	3,567	7,153	15	10,866
1890	Lord Moreton	122	58	3,846	6,941	17	10,984
1891	2nd Earl of Ravensworth	117	60	3,811	6,921	19	10,928
1892	1st Earl of Feversham	111	69	3,784	7,066	20	11,050
1893	1st Duke of Westminster, K.G.	107	74	3,786	7,138	21	11,126
1894	8th Duke of Devonshire, K.G.	113	73	3,798	7,212	22	11,218
1895	Sir J. H. Thorold, Bart.	120	80	3,747	7,179	23	11,149
1896	Sir Walter Gilbey, Bart.	126	83	3,695	7,253	23	11,180
1897	H.R.H. The Duke of York, K.G.	126	83	3,705	7,285	24	11,223
1898	5th Earl Spencer, K.G.	121	79	3,687	7,182	25	11,094
1899	9th Earl of Coventry	116	75	3,656	7,009	23	10,879
1900	H.R.H. The Prince of Wales, K.G.	111	71	3,628	6,832	24	10,666
1901	3rd Earl Cawdor	102	70	3,564	6,338	27	10,033

TABLE SHOWING THE NUMBER OF GOVERNORS AND MEMBERS IN EACH YEAR FROM THE ESTABLISHMENT OF THE SOCIETY—*contd.*

Year.	President of the Year.	Governors.		Members.			Total.
		Life.	Annual.	Life.	Annual.	Honor-ary.	
1902	H.R.H. Prince Christian, K.G. ..	100	69	3,500	5,955	26	9,650
1903	H.R.H. The Prince of Wales, K.G.	99	62	3,439	5,771	27	9,398
1904	16th Earl of Derby, K.G.	96	68	3,375	5,906	32	9,477
1905	9th Lord Middleton	89	78	3,212	5,758	33	9,170
1906	Mr. F. S. W. Cornwallis	94	155	3,132	6,189	30	9,600
1907	4th Earl of Yarborough	91	174	3,076	6,299	29	9,669
1908	9th Duke of Devonshire, K.G. ..	89	178.	3,019	6,442	30	9,758
1909	7th Earl of Jersey, G.C.B.	91	177	2,951	6,696	31	9,946
1910	Sir Gilbert Greenall, Bart.	86	166	2,878	6,934	31	10,095
1911	HIS MAJESTY KING GEORGE V. ..	85	168	2,805	7,191	30	10,279
1912	9th Lord Middleton	85	170	2,741	7,283	30	10,309
1913	2nd Earl of Northbrook	89	168	2,691	7,474	26	10,448
1914	Earl of Powis	89	173	2,626	7,629	28	10,545
1915	Duke of Portland, K.G. .. [K.G.	88	184	2,517	7,313	28	10,130
1916	7th Duke of Richmond and Gordon,	83	185	2,427	7,526	27	10,248
1917	Mr. Charles Adeane, C.B.	93	210	2,412	8,214	26	10,955
1918	Hon. Cecil T. Parker	102	224	2,395	8,226	25	10,972
1919	Sir J. B. Bowen-Jones, Bart. ..	119	236	2,411	8,558	24	11,348
1920	H.R.H. The Prince of Wales, K.G.	129	256	2,402	9,208	25	12,020
1921	Mr. R. M. Greaves	137	275	2,374	10,098	24	12,908
1922	H.R.H. The Duke of York, K.G. ..	144	287	2,317	10,596	22	13,366
1923	Lt.-Col. E. W. Stanyforth	153	293	2,262	10,778	20	13,506
1924	Mr. Ernest Mathews, C.V.O. ..	159	289	2,201	10,676	21	13,346
1925	Sir Gilbert Greenall, Bart, C.V.O. ..	158	291	2,160	10,949	15	13,573
1926	Lord Desborough, G.C.V.O.. ..	155	276	2,103	10,251	15	12,800
1927	1st Viscount Tredegar, C.B.E. ..	153	257	2,035	9,343	15	11,803
1928	3rd Lord Harlech, C.B.	155	277	1,972	9,042	16	11,462
1929	Earl of Harewood, K.G.	154	273	1,914	8,813	16	11,170
1930	H.R.H. The Duke of Gloucester, K.G.	158	264	1,882	8,491	16	10,811
1931	Sir Arthur Hazlerigg, Bart. ..	153	245	1,823	8,036	16	10,273
1932	Lord Mildmay of Flete	144	223	1,774	7,501	13	9,655
1933	9th Duke of Devonshire, K.G. ..	140	212	1,707	7,367	13	9,439
1934	Earl of Stradbroke, K.C.M.G. ..	140	205	1,666	7,141	17	9,169
1935	H.R.H. The Duke of Kent, K.G. ..	142	201	1,614	7,029	18	9,004
1936	Sir Merrik R. Burrell, Bart., C.B.E.	140	196	1,588	7,027	17	8,968
1937	Mr. U. Roland Burke..	135	195	1,560	6,854	15	8,759
1938	Earl of Plymouth	133	206	1,547	6,961	18	8,865

STATEMENT made to the Council by the Chairman of the Finance Committee, on presenting the Accounts for the year 1937.

Mr. ADEANE (Chairman of Finance Committee) moved the adoption of the Accounts for the year ended December 31st, 1937. The total receipts for the year, including the balance of £3,022 brought forward from the last Account, and £396 supplementary receipts, amounted to £22,136. The total payments, ordinary and extraordinary, amounted to £18,676, leaving a balance to carry forward of £3,460. With regard to the Balance Sheet, the net depreciation in the market value of the Society's Reserve Fund investments was £8,170, but, as £5,000 of new money had been invested during the last year, the net fall was only £3,170. The following investment transactions took place during the year: the Society sold 3½ per cent. Conversion Stock to realize £3,000, and purchased £3,000 of Eastbourne Water Works Co.'s Mortgages. They also purchased 3 per cent. Redemption Stock at a cost of £5,000.

With regard to the Estimates of Receipts and Expenditure for the present year, it was estimated that the Receipts would amount to £18,742 and the Expenditure to £18,719, leaving a surplus of £23.

Figures for 1936. £	Receipts.	£ s. d.	£ s. d.	£ s. d.
	CASH AT BANKERS AND IN HAND, JANUARY 1, 1937 :—			
148	Reserve Fund Account		118 0 0	
3,241	Current Account		2,721 1 1	
190	Petty Cash at Bank and in Hand ..		183 12 10	
3,579				3,022 13 11
	SUBSCRIPTIONS :—			
1,101	Annual Governors	1,078 2 2		
7,196	Annual Members	7,092 9 3		
30	Life Governors and Members	31 8 0		
80	For previous years	50 8 0		
8,407			8,252 7 5	
	JOURNAL OF THE SOCIETY :—			
241	Advertisements	260 4 2		
111	Sales and Reprints	139 17 9		
352			400 1 11	
	EXAMINATIONS :—			
568	National Diploma in Agriculture	694 18 10		
414	National Diploma in Dairying	406 4 3		
982			1,101 3 1	
	MISCELLANEOUS :—			
7,336	Interest on Investments	7,311 18 5		
446	Income Tax refunded	503 11 11		
41	Bank Interest	76 5 10		
29	Sales of Pamphlets, etc.	23 1 9		
178	Sales of Text Book	184 12 3		
30	Hire of Rooms	26 15 6		
110	Donations	105 8 0		
250	Argentine Rural Society	200 0 0		
105	Park Royal Drainage Rate	154 7 2		
256	Rent, 12, Hanover Square	251 12 6		
—	Research Grant : part refunded	32 10 6		
—	Tractor Tests : entry fees, etc.	93 10 0		
8,781			8,963 13 10	
18,522	TOTAL OF ORDINARY RECEIPTS ..			18,717 6 3
	Life Compositions of Governors and			
478	Members		278 18 0	
100	Subscriptions for 1938		116 3 0	
2	Show Account : Postage, etc., Dec., 1936		1 14 3	
6	,, ,, *Prize Fund Interest* ..		.	
5	*Sales of Show Plant*		.	
591				396 15 3
£22,692				£22,136 15 5

Figures for 1936. £	Payments.	£ s. d.	£ s. d.	£ s. d.
	GENERAL ADMINISTRATION :—			
4,086	Salaries and Wages	4,491 4 2		
475	Pensions	465 16 7		
423	Legal Charges, Auditors' Fees, etc.	246 9 2		
998	Rent, Rates, and House Expenses	1,013 16 2		
382	Printing and Stationery	483 18 6		
398	Postage, Telephone and Sundries	386 3 4		
6,762			7,087 7 11	
	JOURNAL OF THE SOCIETY :—			
1,422	Volume 97	1,475 11 3		
48	*Re* Volume 98, etc.	48 2 3		
1,470			1,523 13 6	
	SCIENTIFIC DEPARTMENTS :—			
409	Chemist's Salary and Petty Cash	411 1 2		
250	Botanist's Salary	250 0 0		
200	Zoologist's Salary	200 0 0		
400	Grant to Royal Veterinary College	400 0 0		
50	Grant to Research Institute, Reading	50 0 0		
3	Medal *re* Cattle Pathology	2 13 2		
1,312			1,313 14 4	
	EXAMINATIONS :—			
619	National Diploma in Agriculture	675 15 2		
410	National Diploma in Dairying	563 16 2		
1,029			1,239 11 4	
	MISCELLANEOUS :—			
1,945	Grant to Research Fund	1,870 0 0		
28	Library: Books, etc.	18 3 4		
37	Repairs, etc., to House and Furniture	137 0 9		
10	Medals, etc., for Long Service	10 11 0		
—	Presidents' Album	12 12 0		
450	*"Elements of Agriculture," new edition*	—		
49	*Cleaning and Lighting Picture*	—		
675	*Donations and Grants to Royal Veterinary College and others*	—		
44	*Governors' Ladies' Badges*	—		
—	Tractor Tests	175 4 7		
23	Gold Medal and Album	4 17 6		
250	Argentine Rural Society	200 0 0		
227	Park Royal Drainage Rate	330 8 2		
256	Rent, 12, Hanover Square	251 12 6		
3,500	Amount set aside against Loss on Shows (to Invested Reserve Fund)	3,500 0 0		
7,494			6,510 9 10	
18,067	TOTAL OF ORDINARY PAYMENTS			17,674 16 11
2	Show Account: Postage, etc., Dec., 1937		15 5 4	
—	,, ,, Prize Fund Interest		6 0 6	
1,498	Invested Reserve Fund		811 12 0	
12	Additions to Furniture		18 18 6	
60	,, ,, Show Plant		149 12 0	
30	*Argentine Rural Society*		—	
1,602				1,001 8 4
	CASH AT BANKERS AND IN HAND, DECEMBER 31, 1937 :—			
418	Reserve Fund Account		80 19 0	
2,421	Current Account		3,216 1 8	
184	Petty Cash at Bank and in Hand		163 9 6	
3,023				3,460 10 2
£22,692				£22,136 15 5

BALANCE SHEET

Figures for 1936. £		£ s. d.	£ s. d.	£ s. d.
	CAPITAL AND RESERVE FUND—			
243,886	As at December 31, 1936		244,061 10 3	
	SHOW FUND—			
3,500	Contribution from Ordinary Account to Show Fund	3,500 0 0		
1,667 (*less*)	*Add:* Surplus on Wolverhampton Show ..	680 6 8		
—	Contribution from Bristol Local Committee *re* 1936 Show	188 8 0		
—	Contribution from Newcastle-on-Tyne Local Committee *re* 1935 Show	80 8 1		
1,833			4,449 2 9	
245,719			248,510 13 0	
	RECEIPTS AND PAYMENTS ACCOUNT—			
	Ordinary Receipts	18,717 6 3		
	Ordinary Payments	17,674 16 11		
455			1,042 9 4	
478	Life Compositions received in 1937 ..		278 18 0	
134	Subscriptions in advance received in 1936		99 11 0	
246,786			249,931 11 4	
2,134	*Less:* Depreciation in market values of Investments		8,170 5 10	
244,652			241,761 5 6	
254	*Less:* Adjustment *re* outstanding Assets and Liabilities		28 15 11	
244,398			241,732 9 7	
	DEPRECIATION, written off, viz.:—			
32	Furniture, Fittings, etc.	30 19 10		
205	Show Plant	198 19 7		
100	*Lease of 16 Bedford Square*	—		
337			229 19 5	
244,061				241,502 10 2
	SUNDRY CREDITORS—			
3,676	Sundry Accounts owing		1,887 19 7	
100	Subscriptions for 1938 received in 1937 ..		116 3 0	
3,776				2,004 2 7
£247,837				£243,506 12 9

NOTE.—There are commitments in respect of Contracts entered into in connexion with the forthcoming Show.

T. B. TURNER,
Secretary.

Having examined the foregoing Statement of Receipts and Payments and Balance Sheet with the books sets forth the cash transactions of the Society for the year 1937 and that the Balance Sheet sets forth Investments were at the close of the year duly inscribed in the name of the Society or of Trustees on its Society's Bankers.

3, Frederick's Place,
Old Jewry, London, E.C.2.

DECEMBER 31, 1937.

Figures for 1936. £		£ s. d.	£ s. d.
	RESERVE FUND INVESTMENTS AT MARKET PRICES ON DECEMBER 31, 1937 :—		
164,466	£151,788 14*s.* 11*d.* 3½% Conversion Stock (1961 or after) @ 102½	155,583 9 3	
2,961	£2,840 13*s.* 6*d.* Metropolitan 3% Consolidated Stock (1941) @ 103½	2,940 2 0	
6,854	£6,528 1*s.* 6*d.* Dominion of Canada 4% Registered Stock (1940–60) @ 104	6,789 4 0	
2,752	£2,724 11*s.* 7*d.* Metropolitan Water 3% (E) Stock (1953–73) @ 95	2,588 7 0	
13,336	£12,234 12*s.* 5*d.* Commonwealth of Australia 4% Registered Stock (1955–70) @ 105	12,846 7 0	
7,209	£6,800 14*s.* 2*d.* Union of South Africa 3½% Inscribed Stock (1953–73) @ 102	6,936 14 6	
7,345	£6,500 Dominion of Canada 4% Registered Stock (1953–58) @ 109	7,085 0 0	
11,827	£11,371 18*s.* Commonwealth of Australia 3¾% Registered Stock (1946–49) @ 101	11,485 12 4	
3,532	£3,430 Central Electricity Board 3½% Stock (1963–93) @ 98	3,361 8 0	
5,073	£4,719 London, Midland & Scottish Rly. Co. 4% Debenture Stock @ 104	4,907 15 3	
4,982	£4,914 2*s.* 8*d.* 3% Funding Stock (1959–69) @ 97¾	4,803 11 3	
3,822	£3,784 9*s.* 10*d.* Croydon Corporation 3% Redeemable Stock (1956–8) @ 96	3,633 2 2	
3,331	£3,416 8*s.* 4*d.* Railway Finance Corporation 2½% Guaranteed Debenture Stock (1951–2) @ 95 ..	3,245 11 11	
—	£3,000 Eastbourne Waterworks Co. 4% Series "B" Mortgages @ 100 (cost)	3,000 0 0	
—	£5,513 1*s.* 1*d.* 3% Redemption Stock (1986–96) @ 92¾	5,113 7 2	
237,490			**234,319 11 10**
	FURNITURE, FITTINGS, FIXTURES, ETC.—		
	As at December 31, 1936	290 19 5	
	Added during 1937	18 18 6	
		309 17 11	
	Less Depreciation @ 10%	30 19 10	
291			**278 18 1**
1,500	PICTURES (£500) and BOOKS (£1,000)		**1,500 0 0**
	SHOW PLANT—		
	As at December 31, 1936	1,840 3 7	
	Added during 1937	149 12 0	
		1,989 15 7	
	Less Depreciation @ 10%	198 19 7	
1,840			**1,790 16 0**
1,082	EXPENDITURE (less amounts received) *re* CARDIFF SHOW		**1,131 5 0**
323	SUNDRY DEBTORS		**434 4 0**
334	RATES PAID IN ADVANCE AND INCOME TAX RECOVERABLE		**377 13 9**
	CASH AT BANKERS AND IN HAND—		
418	Reserve Fund Account	80 19 0	
—	Investment Account	260 14 9	
2,421	Current Account	3,216 1 8	
184	Petty Cash at Bank and in Hand	163 9 6	
3,023		3,721 4 11	
(*Add*) 1,954	*Less :* Show Account—Overdrawn	47 0 10	
4,977			**3,674 4 1**
£247,837			**£243,506 12 9**

and vouchers of the Society, we report to the Members of the Society that in our opinion the Statement truly correctly its financial position on the 31st December, 1937. We have satisfied ourselves that the Society's behalf or, where the stocks are registered, that the certificates of title were then in the possession of the

PRICE, WATERHOUSE & CO.,
Chartered Accountants,

Royal Agricultural Society of England.

STATEMENTS RELATING TO FUNDS HELD BY THE SOCIETY IN TRUST OR WHICH ARE NOT CONSIDERED AVAILABLE FOR GENERAL PURPOSES.

RECEIPTS AND PAYMENTS ACCOUNTS FOR 1937.

E. H. HILLS' BEQUEST.

Receipts.	£ s. d.	Payments.	£ s. d.
To Interest	252 15 10	By Grants to Cambridge University	252 15 10

QUEEN VICTORIA GIFTS FUND.

Receipts.	£ s. d.	Payments.	£ s. d.
To Cash at Bank, January 1, 1937	97 14 10	By Grant to Royal Agricultural Benevolent Institution	150 0 0
,, Interest and Income Tax Refunded	148 16 2	,, Cheque Book	4 2
		,, Cash at Bank, December 31, 1937	96 6 10
	£246 11 0		£246 11 0

GILBEY FUND.

Receipts.	£ s. d.	Payments.	£ s. d.
To Interest and Income Tax refunded	£43 8 10	By Grants to Cambridge University	£43 8 10

SUPERANNUATION AND INSURANCE FUND.

Receipts.	£ s. d.	Payments.	£ s. d.
To Cash at Bank, January 1, 1937	426 18 3	By Premiums on Policies	60 12 3
,, Society's contribution to Pension	365 16 7	,, Pension to late Secretary	500 0 0
,, Interest on Investments	358 17 11	,, Income Tax	75 5 9
,, Bank Interest	2 2 10	,, Cash at Bank, December 31, 1937	517 17 7
	£1,153 15 7		£1,153 15 7

"MERCHANTS OF THE STAPLE OF ENGLAND" FUND.

Receipts.	£ s. d.	Payments.	£ s. d.
To Cash with Society on January 1, 1937 ..	6 0 6	By Prizes awarded	14 3 2
,, Interest and Income Tax refunded	14 1 2	,, Cash with Society, December 31, 1937 ..	5 18 6
	£20 1 8		£20 1 8

STATEMENTS RELATING TO FUNDS HELD IN TRUST—*continued.*

CAPITAL STATEMENTS AT DECEMBER 31, 1937.

E. H. Hills' Bequest.

	£	s.	d.		£	s.	d.
To amount bequeathed for Pot-culture Experiments	9,000	0	0	By £7,222 15*s.* 0*d.* $3\frac{1}{2}\%$ Conversion Stock (1961 or after) (purchased on sale of War Stock) at cost	5,616	1	10
Less : Depreciation on and cost of conversion of Consols	3,717	2	6	(*Market Value, December* 31, 1937, at $102\frac{1}{2}$ = £7,403 6*s.* 4*d.*)			
	5,282	17	6				
To surplus on sale of 5% War Stock	333	4	4				
	£5,616	1	10		£5,616	1	10

Queen Victoria Gifts Fund.

	£	s.	d.		£	s.	d.
To Fund originally invested (the income from this Fund is used to make Annual Grants to unsuccessful applicants for pension through the Royal Agricultural Benevolent Institution)	5,000	0	0	By Investments in names of Trustees : at cost :			
Less : Loss on sales of stocks	110	18	0	£1,045 19*s.* 3*d.* Dominion of Canada $3\frac{1}{4}\%$ Registered Stock, 1950–55	1,017	7	0
				£2,046 11*s.* 8*d.* Commonwealth of Australia $3\frac{1}{2}\%$ Registered Stock, 1954–59	2,099	18	10
	4,889	2	0	£1,000 London Midland & Scottish Railway Consolidated 4% Guaranteed Stock	1,556	15	9
,, Undistributed income	96	6	10	£190 4*s.* 6*d.* $2\frac{1}{2}\%$ Consols	215	0	5
					4,889	2	0
				By Cash at Bank, December 31, 1937	96	6	10
	£4,985	8	10		£4,985	8	10

(The market values of the Stocks on December 31, 1937, amounted to £4,183 2*s.* 1*d.*)

Royal Agricultural Society of England.

STATEMENTS RELATING TO FUNDS HELD BY THE SOCIETY IN TRUST OR WHICH ARE NOT CONSIDERED AVAILABLE FOR GENERAL PURPOSES.

RECEIPTS AND PAYMENTS ACCOUNTS FOR 1937.

E. H. Hills' Bequest.

Receipts.	£ s. d.	Payments.	£ s. d.
To Interest	252 15 10	By Grants to Cambridge University	252 15 10

Queen Victoria Gifts Fund.

Receipts.	£ s. d.	Payments.	£ s. d.
To Cash at Bank, January 1, 1937	97 14 10	By Grant to Royal Agricultural Benevolent Institution	150 0 0
,, Interest and Income Tax Refunded	148 16 2	,, Cheque Book	4 2
		,, Cash at Bank, December 31, 1937	96 6 10
	£246 11 0		£246 11 0

Gilbey Fund.

Receipts.	£ s. d.	Payments.	£ s. d.
To Interest and Income Tax refunded	£43 8 10	By Grants to Cambridge University	£43 8 10

Superannuation and Insurance Fund.

Receipts.	£ s. d.	Payments.	£ s. d.
To Cash at Bank, January 1, 1937	426 18 3	By Premiums on Policies	60 12 3
,, Society's contribution to Pension	365 16 7	,, Pension to late Secretary	500 0 0
,, Interest on Investments	358 17 11	,, Income Tax	75 5 9
,, Bank Interest	2 2 10	,, Cash at Bank, December 31, 1937	517 17 7
	£1,153 15 7		£1,153 15 7

"Merchants of the Staple of England" Fund.

Receipts.	£ s. d.	Payments.	£ s. d.
To Cash with Society on January 1, 1937 ..	6 0 6	By Prizes awarded	14 3 2
,, Interest and Income Tax refunded	14 1 2	,, Cash with Society, December 31, 1937 ..	5 18 6
	£20 1 8		£20 1 8

STATEMENTS RELATING TO FUNDS HELD IN TRUST—*continued.*

CAPITAL STATEMENTS AT DECEMBER 31, 1937.

E. H. Hills' Bequest.

	£	s.	d.
To amount bequeathed for Pot-culture Experiments	9,000	0	0
Less : Depreciation on and cost of conversion of Consols	3,717	2	6
	5,282	17	6
To surplus on sale of 5% War Stock	333	4	4
	£5,616	1	10

	£	s.	d.
By £7,222 15*s.* 0*d.* 3½% Conversion Stock (1961 or after) (purchased on sale of War Stock) at cost	5,616	1	10
(*Market Value, December* 31, 1937, at 102½ = £7,403 6*s.* 4*d.*)			
	£5,616	1	10

Queen Victoria Gifts Fund.

	£	s.	d.
To Fund originally invested (the income from this Fund is used to make Annual Grants to unsuccessful applicants for pension through the Royal Agricultural Benevolent Institution)	5,000	0	0
Less : Loss on sales of stocks	110	18	0
	4,889	2	0
,, Undistributed income	96	6	10
	£4,985	8	10

	£	s.	d.
By Investments in names of Trustees : at cost :			
£1,045 19*s.* 3*d.* Dominion of Canada 3¼% Registered Stock, 1950–55	1,017	7	0
£2,046 11*s.* 8*d.* Commonwealth of Australia 3½% Registered Stock, 1954–59	2,099	18	10
£1,000 London Midland & Scottish Railway Consolidated 4% Guaranteed Stock	1,556	15	9
£190 4*s.* 6*d.* 2½% Consols	215	0	5
	4,889	2	0
By Cash at Bank, December 31, 1937	96	6	10
	£4,985	8	10

(The market values of the Stocks on December 31, 1937, amounted to £4,183 2*s.* 1*d.*)

STATEMENTS RELATING TO FUNDS HELD IN TRUST—*continued*.

CAPITAL STATEMENTS AT DECEMBER 31, 1937.

GILBEY FUND.

	£	s.	d.		£	s.	d.
To Amount provided by the late Sir Walter Gilbey for endowment of Lectureship at Cambridge University	1,000	0	0	By Investment at cost :— £1,457 5*s.* 2*d.* Metropolitan Water Board 3% (A) Stock, 1963–2003	1,204	10	4
,, Accumulation of Interest	204	10	4	(*Market Value, December* 31, 1937, at $88\frac{1}{2}$ = £1,289 13*s.* 5*d.*)			
	£1,204	10	4		£1,204	10	4

SUPERANNUATION AND INSURANCE FUND.

	£	s.	d.		£	s.	d.
To amount set aside in accordance with declaration of Trust of July 26, 1911	9,171	5	0	By investments in names of Trustees, at cost :— £9,028 0*s.* 7*d.* $3\frac{1}{2}$% War Stock (1952 or after)	8,453	7	8
Less : Depreciation on and cost of conversion of Consols	2,094	1	4	£827 4*s.* 4*d.* West Australian $3\frac{1}{2}$% Inscribed Stock (1935–55)	659	17	4
				£794 6*s.* 1*d.* Queensland $3\frac{1}{2}$% Inscribed Stock (1950–70)	620	0	9
	7,077	3	8				
,, Proceeds of Policy surrendered	1,167	0	0		9,733	5	9
,, Accumulation to December 31, 1937 ..	1,927	9	10	By Cash at Bank, December 31, 1937	517	17	7
	10,171	13	6	(The market values of the Stocks on December 31, 1937, amounted to £10,767 3*s.* 3*d.*)			
,, Income Tax on untaxed Interest	79	9	10				
	£10,251	3	4		£10,251	3	4

STATEMENTS RELATING TO FUNDS HELD IN TRUST—*continued.*

CAPITAL STATEMENTS AT DECEMBER 31, 1937.

"Merchants of the Staple of England" Fund.

	£	s.	d.		£	s.	d.
To capital sum paid by the "Merchants of the Staple of England" for the purpose of providing out of the yearly income Prizes to be competed for annually in the Wool Section of the Royal Show	500	0	0	By Investments at cost :— £526 11*s.* Commonwealth of Australia 3% Registered Stock, 1955–58	522	12	9
To bonus on Conversion of original Stock	22	12	9	,, Cash with Society, December 31, 1937	5	18	6
,, undistributed income	5	18	6	(*Market Value of Stock, December* 31, 1937, at 90 = £473 17*s.* 10*d.*)			
	£528	11	3		£528	11	3

Having examined the foregoing Statements of Trust Funds with the books and vouchers of the Society, we report to the Members of the Society that in our opinion the Statements truly set forth the transactions relating to these Funds during the year 1937, and the state of the Funds at the close of the year. We have satisfied ourselves that the Investments set forth were duly inscribed at the close of the year in the names of the Trustees or where the stocks are registered, that the certificates of title were in the possession of the Society's bankers.

3, Frederick's Place,
Old Jewry, London, E.C.2.
14*th February*, 1938.

PRICE, WATERHOUSE & CO.,
Chartered Accountants,
Accountants and Auditors.

Royal Agricultural Society of England.

RESEARCH COMMITTEE.

RECEIPTS AND PAYMENTS FOR YEAR 1937.

RECEIPTS.	£	s.	d.
To Grant from General Account	1,870	0	0
	£1,870	0	0

PAYMENTS.	£	s.	d.
By Grants to Research Institute in Animal Pathology, Royal Veterinary College, for Research on Calf Diseases	300	0	0
,, Grants to Rothamsted Experimental Station for :—			
Lucerne, etc., Inoculation Experiments ..	50	0	0
Electricity on the Farm Investigation ..	200	0	0
Cake Feeding on Grassland Experiments ..	250	0	0
,, Grant to Norfolk Agricultural Station for Experiments *re* disposal of Beet Tops and Straw	300	0	0
,, Grant to Welsh Plant Breeding Station *re* Grass Seeds Mixture Trials	300	0	0
,, Grant to King's College, Newcastle-on-Tyne, *re* Tick Eradication from Sheep Grazings ..	100	0	0
,, Editing, etc.	20	0	0
,, *Farmer's Guide to Agricultural Research in* 1936 :—			
Honoraria to Contributors	350	0	0
	£1,870	0	0

Examined, audited and found correct,

PRICE, WATERHOUSE & CO.,
Chartered Accountants,
Accountants and Auditors.

3, Frederick's Place,
Old Jewry, London, E.C.2.
14th February, 1938.

STATEMENT made to the Council by the Chairman of the Finance Committee, on presenting the Accounts of the Cardiff Show, 1938.

Mr. ADEANE moved the part of the Report relating to the Cardiff Show. He said that the details of the accounts were in the hands of Members of the Council and he hoped they might be taken as read. The financial result of the Show was disappointing and showed a loss of £3,263. If the Cardiff figures were compared with Wolverhampton it would be seen how this loss had been arrived at. The fees for implements were down by £1,781. The receipts from the car parks showed a decrease of £1,429, and the gate was less by £1,207; the latter was no doubt affected by the weather. On the side of expenditure there was a saving of £1,346 on the erection of the Showyard. In the face of the undoubted success of the Show, he thought they could ignore the loss. It was futile to compare the financial results of the Cardiff Show in 1919 with the Show held at Cardiff this year because the conditions were very different. The year 1919 was one of soaring prices, 1938 a year of depression, especially in that part of Wales in which Cardiff is situated. The Show itself was in every way excellent, the site all that could be desired, and so was the warm welcome which the Society received from the city of Cardiff.

On this occasion reference was generally made to those who had so kindly helped the Society in connexion with the Show. First of all, their warm thanks were due to the President. It would be impossible to have an abler or more courteous President than Lord Plymouth, and Lady Plymouth shared their thanks for the gracious manner in which she supported the President in connexion with the Cardiff Show. They were especially grateful to Lord Plymouth for finding time to attend the meetings of the Council so regularly, in spite of his work elsewhere, and he was sure it was the hope of the Council that he would continue to take an interest in the Society and that they might have the pleasure and benefit of his attendance at meetings of the Council in the future. It was a great relief to hear that Mr. Burke was making such a good recovery after his operation, and they all hoped soon to see him completely restored to health. He did not think they realized the enormous amount of work which fell on the shoulders of the Honorary Director of the Show. Not only did he have to plan for the Show for the current year, but he had to prepare the way for future Shows two, or even three, years ahead. This entailed an immense amount of hard work and travelling, and all this was in addition to his other work. The Council was greatly indebted to him. They would, he knew, like to acknowledge the work done by Mr. Turner and his staff. The success of the Society's efforts was very much due to their assistance which was always willingly given.

JULY 5 to

Figures for 1937 Show £	Receipts.	£ s. d.	£ s. d.
2,000	Contributions from Cardiff Local Committee to Show Fund.*		6,141 16 10
—	Contribution from Society's Ordinary Account		500 0 0
—	Donations		51 2 0
	CONTRIBUTIONS TO PRIZE FUND :—		
2,225	Agricultural and Breed Societies and others	2,098 14 0	
68	*Cardiff Local Committee*	— — —	
2,293			2,098 14 0
11,867	FEES FOR IMPLEMENTS, MACHINES AND MISCELLANEOUS EXHIBITS		10,086 9 4
	FEES FOR ENTRY OF LIVE STOCK :—		
6,687	Members	6,042 5 0	
627	Non-members	368 12 6	
7,314			6,410 17 6
171	FEES FOR ENTRY OF POULTRY AND EGGS		152 1 0
	OTHER ENTRY FEES :—		
103	Produce	103 10 0	
160	Horse-jumping Competitions	134 0 0	
14	Plantations Competition	25 13 0	
38	Butter-making Competitions	36 15 0	
315			299 18 0
	CATALOGUE :—		
854	Advertising in Catalogue and extra lines	726 19 10	
926	Sales of Catalogue	610 19 5	
41	Sales of Daily Programmes	55 16 0	
1,821			1,393 15 3
	ADMISSIONS TO SHOWYARD :—		
1,054	Tuesday, July 5, @ 5*s.*	978 9 6	
4,089	Wednesday, July 6, @ 5*s.* and 3*s.*	3,289 13 8	
4,149	Thursday, July 7, @ 3*s.*	3,104 16 1	
1,226	Friday, July 8, @ 2*s.* 6*d.*	1,430 5 4	
617	Saturday, July 9, @ 1*s.*	1,118 11 10	
184	Season Tickets	158 13 9	
749	Day and other Tickets	780 16 0	
12,068			10,861 6 2
£37,849	Carried forward		£37,996 0 1

JULY 9, 1938.

Figures for 1937 Show £	Expenditure.	£	s.	d.	£	s.	d.
	COST OF ERECTION AND MAINTENANCE OF SHOWYARD :—						
2,342	Transferring Society's permanent buildings from Wolverhampton and re-erecting at Cardiff	2,231	10	9			
560	Fencing round Showyard	472	4	7			
2,160	Implement Shedding	1,809	15	8			
6,590	Stock Shedding and Sleeping Boxes	5,684	18	1			
2,669	Grand Stand, Offices, Rings, Signs, etc.	2,847	3	7			
1,369	General Labour, Horse and Motor Hire	1,507	1	5			
230	Hire of Sleepers	176	2	8			
1,820	Hire of Canvas	1,665	5	7			
					16,394	2	4
17,740							
	EXTRAORDINARY EXPENDITURE :—						
—	Compensation to Tenant, cost of preparing and restoring ground, and providing Electricity and Water				3,818	15	11
	SURVEYOR :—						
739	Salary, Travelling and Sundry Expenses	752	12	10			
299	Clerk of Works: Salary, Travelling, etc.	302	17	5			
					1,055	10	3
1,038							
	PRINTING :—						
657	General Printing, Prize Sheet, Tickets, etc.	685	19	4			
1,115	Catalogue, Award Lists and Programmes	994	12	4			
					1,680	11	8
1,772							
	ADVERTISING :—						
910	Newspaper Advertising	926	11	9			
347	Billposting and Window Cards, etc.	307	0	5			
110	Advertisement Boards	172	10	11			
					1,406	3	1
1,367							
193	POSTAGE, CARRIAGE, ETC.				213	11	5
12,504	AMOUNT OF PRIZES AWARDED (including £2,098 14*s*. 0*d*. given by various Societies and others—per contra)				12,323	9	0
927	FORAGE FOR LIVE STOCK				855	8	8
550	JUDGES OF STOCK: FEES AND EXPENSES				596	16	4
£36,091	Carried forward				£38,344	8	8

Figures for 1937 Show £	Receipts (*contd.*).	£	s.	d.	£	s.	d.
37,849	Brought forward				**37,996**	**0**	**1**
	ADMISSIONS TO GRAND STAND :—						
909	Reserved Seats	436	6	3			
1,023	Unreserved Seats	1,078	0	6			
					1,514	**6**	**9**
1,932							
	MISCELLANEOUS RECEIPTS :—						
989	Admissions to Flower Show	782	8	2			
2,667	Motor Parks	1,238	5	0			
111	Rent for Railway Offices	111	0	0			
400	Premium for Catering	400	0	0			
50	Premium for Cloak Rooms	50	0	0			
50	Rent of space for Ministry of Agriculture	50	0	0			
130	Advertisements in Stock Prize Sheet	105	19	6			
136	Sales of Produce at Dairy	130	9	3			
9	Wolverhampton Show :—Outstanding items	40	7	9			
10	Sundry Receipts	17	12	5			
					2,926	**2**	**1**
4,552							
£44,333					**£42,436**	**8**	**11**
—	Debit Balance				**3,263**	**4**	**5**
£44,333					**£45,699**	**13**	**4**

*NOTE.—The contribution of the Cardiff Local Committee to the Show Fund represents the balance of the Local Fund (after deducting expenses of collection and management); and is intended to cover (1) the usual contribution of £2,000 made by Local Committees to the Show Fund; (2) Extraordinary Expenditure usually defrayed by Local Committees in providing and preparing the Show-ground and supplying Electricity and Water.

Examined, audited and found correct this 25th day of November, 1938.

T. B. TURNER, *Secretary.*

PRICE, WATERHOUSE & CO., *Chartered Accountants.*

Figures for 1937 Show £	**Expenditure** (*contd.*).	£ s. d.	£ s. d.
36,091	Brought forward		**38,344 8 8**
	GENERAL ADMINISTRATION :—		
268	*Honorary Director* :—Travelling, Entertaining, etc.	247 19 7	
294	*Stewards and Assistants :—Stock, Hospitality, Refreshments and Implements* : Personal and Railway Expenses	307 4 10	
522	*Secretary and Staff* :—Travelling, Maintenance, etc.	498 0 3	
720	*General Management* :—Finance Stewards, Grand Stand Men, Turnstile Men, Bank Staff, £295 13*s*. 9*d*.; Catalogue Sellers, £73 3*s*. 1*d*.; Foremen and Yardmen, £222 4*s*. 3*d*.; Gatekeepers, £126 1*s*. 5*d*.; Commissionaires, £28 4*s*. 9*d*.	745 7 3	
126	*Veterinary Department* :—Inspectors	124 16 2	
179	*Engineering Department* :—Consulting Engineer	148 2 0	
397	Police	450 0 0	
2,506			**2,521 10 1**
	GENERAL SHOWYARD AND MISCELLANEOUS EXPENSES :—		
1,383	*Dairy* :—Building, £510 19*s*. 2*d*.; Steward, Assistants and Staff, £288 2*s*. 5*d*.; Milk, £192 15*s*. 0*d*.; Utensils, £104 4*s*. 8*d*.; Engineers, £104 13*s*. 3*d*.; Miscellaneous, £104 8*s*. 8*d*.	1,305 3 2	
565	*Poultry and Produce* :—Buildings, £343 17*s*. 7*d*.; Miscellaneous, £210 1*s*. 0*d*.	553 18 7	
704	*Flower Show* :—Hire of Tents, etc., £429 13*s*. 8*d*.; Miscellaneous, £220 4*s*. 2*d*.	649 17 10	
69	*Motor Parks* :—Tents, Offices, etc.	21 13 9	
50	Plantations Competition	68 16 8	
257	Forestry :—Tent and Miscellaneous	236 2 6	
783	Military Display and Band	875 12 1	
310	Hire of Furniture	194 16 0	
121	Royal and Official Luncheons	109 0 10	
54	St. John Ambulance	45 18 0	
96	Insurance	99 8 9	
89	Medals and Expenses *re* Cups	72 19 9	
136	Badges and Rosettes	138 10 3	
78	New Implements :—Testing and Medals	79 10 9	
7	Wolverhampton Show :—Outstanding items	6 1 0	
354	Sundry expenses	376 4 8	
5,056			**4,833 14 7**
£43,653			**£45,699 13 4**
680	*Credit Balance*		— — —
£44,333			**£45,699 13 4**

Proceedings at General Meeting of Governors and Members

HELD IN THE CONFERENCE TENT IN CARDIFF SHOWYARD,

At 4 p.m., TUESDAY, JULY 5th, 1938.

THE EARL OF PLYMOUTH (President) IN THE CHAIR.

President's Remarks.

The PRESIDENT, in opening the proceedings, said: "My Lords, Ladies and Gentlemen,—This is the fourth occasion on which the Royal Show has been held at CARDIFF, and it is my privilege to address you to-day as President of the Society in the 99th year of its existence, and at the 97th Show held by our organization.

This is not the time when one reviews the work of the Society for the year, that can be more appropriately done at our Annual Meeting in December. I am told, too, that I am not expected to discuss the Agricultural situation in the country at the present time.

I, therefore, propose to confine my remarks more particularly to the visit of the Royal Agricultural Show to CARDIFF this week.

There must be many factors that must make or mar the success of a Show of this character. Take the site, for instance, on which the Show is staged. Here to-day we have an ideal site kindly placed at our disposal by the Marquis of Bute, and I am sure it would be your wish that we should record our thanks to him for making the visit of the Royal Show possible by arranging for such an excellent site to be placed at our disposal. Then there is the equipment of the site, its preparation and the supply of public services such as Water, Electricity, &c. For this we are indebted to the Officials of the Cardiff Corporation—(Hear, hear)— and we must here record our sincere thanks to them for their supervision of all the work this has entailed.

The question, too, of transport of visitors to the Show must not be overlooked, and I understand that the Chief Constable of Cardiff, Mr. Wilson, has been particularly helpful in the arrangements for the smooth working of vehicular traffic and the parking of motor vehicles. Indeed to all the Officials of the Corporation we owe a debt of gratitude.

You are to hear proposed in a few minutes a special vote of thanks to the Lord Mayor of Cardiff, the Corporation and the Local Committee for all their efforts to promote the success of the Show, and I am sure this will meet with your unanimous approval, but I would like to tell you that the resolution is a most inclusive one and is intended to thank everyone who has in any way helped. It is not possible to mention everyone personally, so that I hope no one will feel that they have been left out in the cold. I do personally and on behalf of the Council of the Royal Agricultural Society of England wish to convey our warmest thanks to everyone who has helped us in connexion with the Show; one person, however, I must mention and that is Mr. Hubert Alexander, our Member of Council for Glamorgan. He has done a great deal for the Society, apart from this Show. He was an active young man and Steward of Forage at the 1919 Show, but his activity seems to have been in no way impaired by the passing of almost 20 years, for he has, as Hon. Treasurer of the Local Fund and with his local knowledge, helped tremendously for a long time now towards the success of this Show. I am afraid we have made serious inroads on his time and his private practice, but we do thank him for his help.

Now a word or two about the Show itself, the Shop Window of Agriculture as everyone calls it. We are fortunate in being able to stage such a magnificent Show here to-day. Our friends the Bath and West and

Southern Counties Society were handicapped owing to outbreaks of Foot and Mouth Disease which precluded Cattle being exhibited at the Plymouth Show, whilst the Royal Counties Show at Bournemouth suffered very heavy damage through a severe storm on the first day of their Show. I do hope, therefore, that we shall be blessed with good weather and favourable conditions during the remainder of the week.

A most comprehensive display of Implements and Machines is made by Exhibitors in that section, and the entries in the Live Stock sections are equal as regards quality to anything that has ever appeared at a Royal Show. I am not going to take up your time by giving you figures; these you may have seen for yourselves in the Catalogue or in the Press, but I do desire to record my personal gratification that there is such a good and representative entry of all our native Welsh Breeds of Stock.

Then, there are the special Agricultural Education and Research exhibits, the Marketing Demonstration of the Ministry of Agriculture, the Electrical Exhibit, Rural Industries Bureau, Federation of Women's Institutes, our own Working Dairy, and so on and so on, all organized for the purpose of educating the farmer as well as the layman, and in pursuance of the Society's motto "Practice with Science."

I must not forget to tell you that we have a very fine Forestry exhibit which all those interested ought to see for themselves.

To-morrow we are to be honoured by a visit from His Royal Highness THE DUKE OF KENT, a Trustee of the Society, a visit we are all looking forward to as it is another expression of the interest the Royal House has always shown in the affairs of the Society and the welfare of the Show. I can, I know, promise him a right royal welcome on your behalf.

One word more, if it is not out of place, and that is regarding the general work of the Society, apart from the Show, its Chemical, Botanical, Zoological, Veterinary, Research and Educational work, details of which it would take me far too long to describe here, but they are valuable privileges and can be obtained by all members who subscribe a minimum of £1 per annum.

Next year is the Centenary year of the Society and the Council is most anxious that the year should be marked by a record increase in the number of Members; at one time the Society had nearly 14,000 Members. This has dropped to about 9,000. I want to make an earnest appeal to all those present to do their utmost to help the Council in this matter. I shall have to refer to this most urgent matter at our Annual Meeting in Smithfield Week in December, but it would help enormously if you would between now and that time treat this question of increasing our membership as most important and do all you can to obtain for us as many new Members as possible before the close of the year. The Secretary, Mr. Turner, will be only too pleased to supply you, either here in the Showyard or from the Society's Office in London, with full particulars of our work and the privileges we offer and the procedure for election to membership.

It now only remains for me to thank you all for the help you have given, for your attendance here to-day, and to express the hope that when the Report of the Show is presented it will record in every way, and perhaps I ought to say particularly financially, that the Cardiff Show of 1938 was one of the most successful Shows held in their long history. (Applause.)

Thanks to Lord Mayor, Corporation and Local Committee.

Mr. U. ROLAND BURKE moved that the best thanks of the Society are due and are hereby tendered to the Lord Mayor, the Corporation of Cardiff, and the Local Committee for their efforts to promote the success of the Show. He felt it, he said, a great honour to be asked to propose this resolution, particularly as he did know perhaps rather more intimately than anyone else the amount of hard work done by the Lord Mayor and the City of Cardiff and the help they had given the Society in their endeavours to make the Show a success. He would also like to refer to the amount of

preliminary spade work of the Lord Mayor's two predecessors, Alderman Fred Evans and Alderman Sir Herbert Hiles, in the arrangements for bringing the Show to Cardiff. The present Lord Mayor would, he was sure, agree that they had rendered much useful assistance in the initial stages.

As Lord Plymouth had said, it was not possible to mention everyone in a resolution of that character, but he would like to thank every department of the Corporation for all the work they had done on the Showground and for their ready help ever since the Show preparations started. He did not think anyone really knew better than he did the large amount of work to be done from the moment they started to erect the Show, but it would be quite impossible without the co-operation and help received from the Corporation and its Officials. On this occasion everyone would agree that their part had been extremely well done. The traffic arrangements had been carried out most efficiently and in this connexion he paid a tribute to the Chief Constable. He also desired to refer especially to Mr. Barker and Mr. Alexander for all they had done in endeavouring to raise the Local Fund required; to Mr. Rees, the Town Clerk, and his staff, and to the Development Committee of Cardiff with Mr. Allin as Secretary.

He did not want to take up the time of the meeting, but he did want to add his own personal thanks to the Lord Mayor and everyone who had given him such splendid help ever since he had had to do with the ground. This was the third Show that he had been associated with in Cardiff and he had every anticipation that the City would back up the Society. Whatever the result at the end of the week, he was sure that the Lord Mayor could feel that he had done everything possible to bring about a successful result. He asked Governors and Members in passing this resolution to do so with the greatest enthusiasm.

Lord Mildmay of Flete said it gave him the greatest possible pleasure to second this proposition. They all realized how deeply they were indebted to the Lord Mayor, to the Corporation, and the Local Committee for all they had done to make the Show a success. He had heard that the Lord Mayor had recently been down to Devonshire and he was very much interested in this, because he was a Devon man himself. It appeared that the Lord Mayor had flown down in record time, but it was said that it took him an hour-and-a-half on the railway to get from Exeter to Torquay. He could hardly believe that, because, His Lordship said, he happened to be a Director of the Great Western Railway Company. They had every hope of seeing the Royal Show during the next few years in the West of England, and, if the Lord Mayor would only pay Devonshire another visit, he would see that he had a special train waiting for him, with a streamlined engine, that would whisk him from one end of the County to the other before he could wink an eye.

But seriously they did realize the very great services rendered by the Lord Mayor in connexion with that Show. He had had experience of many Lords-Lieutenant and Mayors who cut a big figure ceremonially, but the Lord Mayor of Cardiff was not only a talker, he was a doer. He had great powers of organization and what was more he made himself acceptable to all and compelled the respect and regard of all with whom he was brought into contact.

The President then put the resolution to the meeting, and it was carried with acclamation.

The Lord Mayor of Cardiff (Alderman O. Cuthbert Purnell), in responding, said that they in Cardiff were all very delighted when the Royal Agricultural Society accepted the invitation to visit their City in 1938. His two predecessors had done a tremendous amount of work to lay the foundations of what they all hoped would be a most successful Show. Anything that he and his colleagues could do to pursue the matter to a successful conclusion they would be only to happy to do.

He believed that Mr. Alexander's name was down also to respond for the Local Committee. He might say that most of the hard work had fallen on Mr. Alexander's shoulders and he deserved most of the credit.

Lord Mildmay had referred to this trip to Devonshire. On that occasion he had left Cardiff at 11-20 and the plane arrived at 11.40. It took him until half-past twelve to get to the Station alone and then until twenty-five minutes to two to get to Torquay. Probably it was appreciated that he was not in a hurry!

He did want to thank them very much indeed for their expression of thanks to the Corporation that afternoon.

Mr. Hubert Alexander wished to express his personal thanks to the President, to Mr. Burke, and to Lord Mildmay, for so kindly referring to the work done by the Local Committee in connexion with the visit of the Royal Agricultural Society to Cardiff and for the way they had referred to his own efforts. He could only say that his part in the work was just typical of the spirit in which the whole of those associated with him had done their part. They were inspired by the hope of making the visit of the Society this year a successor in success to those that had gone before and he sincerely trusted this hope would be realized. His own association with the Society went back to a period before 1919. In that year he was Steward of Forage. He always looked upon the Steward of that department as the man who carried one of the biggest burdens in connexion with the Show. He knew from experience what the duties meant and anyone occupying that post, he thought, was deserving of the greatest sympathy. But they knew that hard work did no one any harm; it helped in the development of a healthy body and a healthy mind. It had been a great pleasure to him to have been able to help the Society and he begged to thank the Governors and Members for the very kind vote of thanks they had accorded to the Local Committee.

Remarks and Suggestions.

The President then enquired if any Governor or Member had any remarks to make or suggestions to offer that could be referred to the Council for their consideration.

Mr. W. H. Cadman had a suggestion he would like to put before the Council arising from his observations round the Judging Ring. He had noticed, he said, cases where the same exhibitor had two, three, four, and sometimes five entries in the same class. He instanced the Jersey Class 217 where one exhibitor had five entries. He believed that in the past the Society had a rule limiting the number of entries an exhibitor could make in a class, but this was a practice which seemed to have gone into abeyance. The best plan would be to have one or two entries only from each exhibitor in each class. It was now possible for one person to sweep the board and this was very discouraging to small exhibitors and to those who brought their animals long distances at considerable expense. County Agricultural Societies looked to the Royal Agricultural Society for a lead and if the Royal Society permitted that sort of thing, other Societies might do the same.

The President said that this suggestion would receive the consideration of the Council.

Captain Bertram Rolfe suggested that next year the Society should arrange for aeroplanes to fly over London advertising the Show to be held at Windsor. In their advertisements, too, he thought particular reference should be made to one section, that of Sir Arthur Hazlerigg, which provided one of the principal attractions of the Show. Some people said that the Flower Show at the Royal was second only to Chelsea, but he thought it was as good as Chelsea.

The President said this matter would be brought before the Showyard Works Committee.

Thanks to President.

Mr. J. W. Watt said he had the honour and pleasure to move a vote of thanks to Lord Plymouth for his services in the Chair that afternoon. Coming from Carlisle and Cumberland which were as far removed from Cardiff as could be, and with an association of over 70 years with the Society through his late father, he wished to say that their President was well-known to many Cumbrian agriculturists as the owner of one of the best Estates in England. At the beginning of the meeting His Lordship had referred to the Forestry Exhibition, but, with great modesty, he refrained from mentioning that the Gold Medal for the best exhibit in that section had been awarded to the Plymouth Estates. He would strongly advise all owners of woodlands and those interested in sylviculture, to inspect that exhibit.

Mr. B. G. Shorten had great pleasure in seconding the vote of thanks to Lord Plymouth for his services in the Chair. He had, he said, spent a seven-weeks' holiday in the United States recently and he had travelled right through the country. It had been a great pleasure to him to see so many Hereford cattle all over the States, and he could not help connecting that with the Royal Agricultural Society and its Shows. It was pleasing to see how the breed had found its way to distant parts of that country. In some places, though the weather was fine, grass was scarce, yet the animals looked so well. He could not understand how the cattle existed on brambles and the tops of trees. They certainly bore evidence of their ability to thrive on very little in a healthy atmosphere. Many people did not realize the influence of the Royal Show and what a powerful organization they had in the Royal Agricultural Society, headed as it was by so many able men. Their very best thanks were especially due to Lord Plymouth for his great services.

It was a difficult matter to please everybody, and he told the meeting a story of a coloured attendant on a train in which he was travelling in America, who, having been chided for not having acted as he should have done, said, "We does have to do all the work and we does only get kicked; but even the good Lord could not please everybody."

The way in which the Show was laid out this year, Mr. Shorten said, reflected the greatest credit on all concerned.

The vote of thanks to Lord Plymouth was enthusiastically carried.

The President thanked the meeting very much indeed for having accorded him so hearty a vote of thanks for his conduct in the Chair that afternoon. He could assure the meeting that it had been a real pleasure to him to be there, as his duties were considerably lighter than when he took the chair at another Committee which was sitting in London that day and over which he had been accustomed to preside for some time past.

He did want to say that his year of Presidency up to now had been one of pleasure so far as the work was concerned. Although circumstances had not allowed him to take a very active part in the organization of the Show, agriculture was an industry with which he was not only closely associated, but it was one in which he took the greatest interest and the greatest possible pleasure. He could only add that he was proud to feel that he had, in his humble way, with his exhibit in the Forestry section, merited the award of the Society. (Applause.) He sincerely hoped that the exhibit which his Estates' people had put up, really was deserving of the honour it had received.

In conclusion he again thanked the meeting very much indeed and said that he could only join with them all in the hope that, at the end of the week, the records would show that this had been one of the most successful Shows in the annals of the Society. (Applause.)

Proceedings at the Annual General Meeting of Governors and Members

HELD AT THE SOCIETY'S HOUSE, 16, BEDFORD SQUARE, LONDON, W.C. 1,

On WEDNESDAY, DECEMBER 7th, 1938, at 12 noon.

THE EARL OF PLYMOUTH (President) IN THE CHAIR.

President's Opening Remarks.

The PRESIDENT said that he had now come to the end of his term of office. The past year had been a most important one in the history of the Society, although perhaps it had not been so momentous as the next one which, as they knew, was the Centenary Year. As he had told them a year ago, it was a matter of personal regret to him that he was not likely to be able to devote more time to the work of the Society while he was in Government office, and he disliked holding any position as a sinecure, but he thought he had been able to attend every Council meeting during the year except one, and he had kept in touch with the work of the various Standing Committees of the Society as far as he possibly could. He was also able to attend on most of the days at the Show which was held at Cardiff, so that he trusted he would be given credit for endeavouring to further the interests of the Society as far as lay in his power. (Applause.)

He did not intend to keep them long in considering the affairs of the Society, for they all, he hoped, had read the Annual Report. Perhaps, first and foremost, he ought to place the question of the Society's membership. This had been falling off during recent years. There might be various causes for this, especially the great depression in agriculture in various parts of the country; but it was essential that every effort should be made not only to keep up the membership at its present level but to increase it if possible to the maximum obtained in 1925 when, he understood, it was over 13,500. Various suggestions had been offered for obtaining new members, and he thought it was generally agreed that members of the Council themselves, by their own personal influence, were best equipped to obtain these new members. He hoped that a special effort would be made during the Centenary Year, and that the members of the Council would do all they could to bring in new members. Some counties had done quite well during the present year, others not quite so well. On the notice board at the back of the hall would be found a list giving the names of members elected in each county during the present year. This list had not been put up for invidious comparisons between counties but rather to show that the efforts made in some counties had met with success, and he hoped all present would heed the lesson in endeavouring to get new members from their own areas and to persuade all whom they knew at once to become members.

This was one of the most fitting ways in which they could mark the great events of the coming year, when it was hoped that the number of members joining the Society would surpass anything previously known in its history. He appealed most earnestly to all present to take a practical interest in the work of the Society, and the most practical form such interest could take was by obtaining new members.

The Show at Cardiff was a most excellent one in every respect, except the financial. It had resulted in a loss to the Society of over £3,000. This was to be deplored in view of the long and hard work put in by the officials of the Society in preparation for the Show, but doubtless the depression in South Wales and the indifferent weather were responsible. Leaving the question of finance for the moment, he thought it could be said that the site offered to the Society by the Marquis of Bute was one of the most picturesque they had ever had and the Show was in every department one

of the most successful. His Royal Highness the Duke of Kent visited it on the Wednesday, his visit was greatly appreciated, and he believed that the Duke of Kent thoroughly enjoyed the occasion. Perhaps there were fewer visitors from overseas this year than usual. No doubt they were waiting until next year when they would come in great numbers to Windsor.

It would be his honour to announce to the meeting formally in a few moments that His Majesty the King had been graciously pleased to accept the office of President of the Society for 1939. (Applause.) This was in itself a most happy augury and he knew they would all agree that no greater honour could have been paid to the Society than that His Majesty should consent to become its President in the Centenary Year. Indeed, no greater encouragement could have been given to the Society to continue its work on behalf of agriculture. It was further evidence, if such evidence was needed, of the very deep interest which His Majesty himself, and indeed all the members of the Royal Family, took in what was after all one of the greatest of all British industries.

The Members would also be delighted to know that Lord Athlone had consented to act as Deputy President for next year. He had hoped to be at the meeting that day, but had been prevented by another engagement and had written to express his regret at this circumstance and his pleasure at looking forward to acting as His Majesty's deputy:—

BRANTRIDGE PARK,
BALCOMBE, SUSSEX.
November 29th, 1938.

DEAR BURKE,

I am very sorry not to be able to attend the General Meeting of the Royal Agricultural Society next Wednesday, only I have to attend the Government Nursing Committee, of which I am Chairman, the same morning at 11 a.m.

Will you therefore please make my apologies to the President and express to him my regret that I am unable personally to tell the Meeting of the great pleasure with which I am looking forward to the "Royal" of 1939, when I have been deputed to act as The King's Deputy, an honour I much appreciate.

I feel sure that all the Members of the Society will do everything in their power to make the Show at Windsor a unique success.

Yours sincerely,

(Signed) ATHLONE.

Ulick R. Burke, Esq., J.P.

A very influential Committee had been set up in Windsor and details were already under discussion. It would meet again early in the new year, and Members of Council would hear at a future meeting of the various plans to be developed to ensure the success of next year's Show. He would not say too much about the Show on that occasion because he did not want to exhaust at one time all the publicity which they hoped would continue in a constant stream from now until the Show took place. He hoped that a year hence Lord Athlone from that Chair would be able to tell them that the Show at Windsor had surpassed anything they had attempted before.

After the Centenary Show at Windsor they would go in 1940 to Lincoln, in 1941 to Plymouth, and in 1942 to Harrogate. Thus a series of Shows would be held in the East Midlands, the South-West and in Yorkshire. The arranging of these Shows was not an easy task and it was very necessary that the Council and all concerned should receive wholehearted support. The best way to give that support was to make the Society a strong body numerically. It was not merely the Show that deserved supporting, but the other side of the Society's activities, in science and research, which was sometimes forgotten only too easily in considering the more picturesque side of the Show.

He wished to add a few remarks of a personal nature. On relinquishing his position as President of the Society he desired to say that he had most thoroughly enjoyed his year of office, and this he attributed to the fact that although he came to the Society a complete stranger—not indeed to some of the members individually, but a stranger in this particular circle—he had received on every side the greatest kindness and encouragement and all the support that any President could possibly expect. He wished to thank all concerned from the bottom of his heart, and especially to thank the Council for the support given him, and to thank the Secretary, Mr. Turner, who had at all times been only too willing to help and advise him in connexion with any events having to do with the work of the Society. He could not pretend that his duties had been onerous, but at the same time help such as Mr. Turner had given had been of the very greatest assistance to one in his position.

He wished also most especially to thank the Honorary Director of the Show, Mr. Roland Burke. In parenthesis he felt that he was expressing the feeling of all present when he said how sorry they were to hear that Mr. Burke had to undergo an operation, and, on the other hand, how pleased to know that he was making really satisfactory progress. They all hoped he would make a most complete and speedy recovery. He owed him special thanks for what he did in the way of unsparing effort to make his year of office as President easy and happy. No man could have been more helpful than Mr. Burke had been throughout his year. He had relieved him of a considerable amount of work which, in the circumstances in which he was placed, it would hardly have been possible for him to have carried out, but he owed him most gratitude for the part he played at the Show itself for making his own position such a pleasurable one. All this he would not readily forget, and to the Council and officers he would always be very deeply grateful both for the honour conferred upon him in his election to this high office and for the support he had received while occupying it. He relinquished the position with some regret, and he hoped to continue in a more humble capacity to do some work for the Society. (Applause.)

H.M. The King's Acceptance of the Presidency.

The President then formally announced, amid acclamation, that His Majesty the King had graciously accepted the office of President of the Society for the year 1939, and that, upon the invitation of His Majesty, the Earl of Athlone had accepted the office of Deputy President of the Society for next year.

Balance Sheet and Report of Council.

The Balance Sheet for 1937, together with the Statement of Receipts and Expenditure of the Cardiff Show, was presented by the President and formally received.

The President next presented the Report of the Council which was taken as read.

Mr. R. Hornsby moved the adoption of the Report of the Council. They all regretted, he said, the adverse balance on the Show account, the more so because he believed, in 1919 the Cardiff Show produced almost a record in that respect. But he hoped that in the forthcoming year there would be a great influx of overseas visitors, and a great rally around Windsor, so that the Show would be a unique success.

Captain J. Templeton seconded the adoption of the Report.

The Report was adopted.

Election of Trustees.

The President stated that the Governors whose names appear below had been recommended by the Council, under Bye-Law 141, for election as Trustees:—

H.R.H. The Duke of Gloucester, K.G., York House, St. James's Palace, S.W.1.
H.R.H. The Duke of Kent, K.G., 3, Belgrave Square, S.W.1.
Adeane, Charles, C.B., Babraham Hall, Cambridge.
Bedford, Duke of, K.G., Woburn Abbey, Bedfordshire.
Burrell, Sir Merrik R., Bt., C.B.E., Floodgates, West Grinstead.
Crutchley, Percy, Sunninghill Lodge, Ascot, Berkshire.
Desborough, Lord, K.G., Taplow Court, Maidenhead.
Greaves, R. M., Wern, Portmadoc, North Wales.
Hazlerigg, Sir Arthur, Bt., Noseley Hall, Leicestershire.
Mildmay of Flete, Lord, Flete, Ivybridge, Devon.
Powis, Earl of, Powis Castle, Welshpool, Mont.
Stanyforth, Lt.-Col. E. W., C.B., Kirk Hammerton Hall, York.

On a show of hands, the Trustees were re-elected.

Election of Vice-Presidents.

The President said the following Governors had also been recommended by the Council for re-election as Vice-Presidents:—

Burke, U. Roland, Edensor House, Bakewell, Derbyshire.
Courthope, Col. The Right Hon. Sir G. L., Bt., M.C., M.P., Whiligh, Sussex.
Derby, Earl of, K.G., Knowsley, Prescot, Lancashire.
Evens, John, Burton, Lincoln.
Harewood, Earl of, K.G., Harewood House, Leeds.
Harris, Joseph, Brackenburgh Tower, Penrith, Cumberland.
Harrison, William, Albion Iron Works, Leigh, Lancashire.
Hastings, Lord, Melton Constable Park, Norfolk.
Plymouth, Earl of, St. Fagan's Castle, Cardiff.
Portland, Duke of, K.G., Welbeck Abbey, Worksop, Notts.
Smith, Fred, Deben Haugh, Woodbridge, Suffolk.
Stradbroke, Earl of, K.C.M.G., Henham Hall, Wangford, Beccles.

This was agreed to.

Election of Professional Accountants and Auditors.

Mr. F. W. Atherton proposed that Messrs. Price, Waterhouse & Co., be re-elected Professional Accountants and Auditors of the Society's accounts for the ensuing year, in accordance with Bye-Law 119.

Mr. Henry Gridley seconded.

This was agreed to.

Election of Ordinary Members of Council.

The President formally announced, in accordance with Bye-Law 153, the names of the Ordinary Members of Council who had been elected to represent the several Divisions of the Society included in Group A:—

Barclay, E. E., Brent Pelham Hall, Buntingford (Hertfordshire).
Cator, Capt. H. J., M.C., Ranworth Hall, Norwich (Norfolk).
Cullimore, Charles, Christleton, Chester (Cheshire).
Digby, Lord, D.S.O., M.C., Minterne, Dorchester (Dorset).
Dyott, Major R. A., The Manor of Freeford, Lichfield (Staffordshire).
Elgin, Earl of, K.T., Broomhall, Dunfermline (Scotland).
Foster, Major Gordon B., Leysthorpe, Oswaldkirk, York (Yorks., N. Riding).

HALE, WINDHAM E., Mowbreck Hall, Kirkham (Lancashire).
JERVOISE, Major F. H. T., Herriard Park, Basingstoke (Hampshire).
JOHNSTONE, Capt. G. H., Trewithen, Grampound Road (Cornwall).
KILPATRICK, JAMES, Craigie Mains, Kilmarnock (Scotland).
ROBERTSON, WILLIAM, Stamford, Alnwick (Northumberland).
ROBINSON, J. C. E., F.S.I., 15A, St. Paul's Square, Bedford (Bedfordshire).
STEDMAN, Sir L. FOSTER, The Garth, Bassaleg, Newport (Monmouthshire).
STOPFORD SACKVILLE, N. V., Drayton House, Lowick, Kettering (Northamptonshire).
STRAFFORD, Earl of, Wrotham Park, Barnet (Middlesex).
TALBOT-PONSONBY, A. H. B., Hinton Woodlands, Bramdean, Alresford (Hampshire).
WALKER, Sir IAN, Bt., Osmaston Manor, Derby (Derbyshire).
WALKER, JOHN, Knightwick Manor, Worcester (Worcestershire).
WIGLESWORTH, R. T., Rangemore, Rostherne, Knutsford (Cheshire).

Question.

Captain J. TEMPLETON asked what steps the Council were taking with regard to the serious state of the sheep industry in this country.

The PRESIDENT replied that this matter had been before the Council that morning and it had been agreed that the following letter should be addressed to the Minister of Agriculture on the subject:—

SIR,

We have been requested by a unanimous vote of the Council of the Royal Agricultural Society of England to bring to your notice the grave concern felt by this Society at the present critical position of Sheep breeders and feeders.

It is urged that some immediate steps must be taken by His Majesty's Government to tide them over their immediate financial difficulties if the country is not to be faced with a serious decrease in its flocks.

If this decrease is allowed to occur then there will be no hope of His Majesty's Government's avowed policy of building up the fertility of the soil taking place on the lighter types of arable land, and on the poorer grass areas, as for this purpose a large sheep population is essential.

We have been asked to press upon you the extreme importance of the request contained in this letter.

We are, Sir,
Your obedient Servants,

MERRIK R. BURRELL, *Trustee.*
HASTINGS, *Vice-President.*

The Rt. Hon. W. S. Morrison, M.P.,
Minister of Agriculture and Fisheries.

Sir MERRIK BURRELL said that, owing to the fact that the President was a member of His Majesty's Government and could hardly sign a letter of this kind, it would be signed by Lord Hastings and himself.

Vote of Thanks to Retiring President.

Mr. HUBERT ALEXANDER moved:—

That the best thanks of this meeting of Governors and Members be extended to the Earl of Plymouth for the valuable services he has rendered as President during the past year.

He said that he could only inadequately express the general sense of Lord Plymouth's services. He had given of his time during his busy

life, and he had done it with a kindliness and graciousness of manner which had been pleasing to them all. He happened to know more than many of them what Lord Plymouth had done because he lived in his district where both he and the Countess were much loved. He never failed to show his interest in and care for those in his immediate district. They would all agree that he had carried out his Presidential duties with distinction and had laid the Society under a great debt. In asking him to accept this vote of thanks, they all hoped that the year had brought to him also an added interest, and that the benefits which he had bestowed upon the members would be reflected in his own life. He trusted that he would be spared for many years to exercise his influence for good not only in his own neighbourhood or in occupying such positions as he was just vacating, but in that great field of the Empire in which he had rendered such conspicuous service.

Major HANSFORD, in seconding the resolution on behalf of the younger members in the Society, said that the Society was invariably fortunate in its President, but the younger members both of the Council and of the Society felt that they had been greatly honoured this year in their choice of President, who had set a memorable example in his devotion to the Society's interests.

The resolution was put by Mr. Alexander and carried with acclamation.

The PRESIDENT said that he was deeply grateful to the members for this expression of their satisfaction at the way in which he had carried out his duties during the past year, and he particularly appreciated the words of the mover and seconder. Mr. Alexander was an old friend of his, and it was quite obvious that testimony from those who knew one was all the more appreciated. But he wished to take this opportunity in turn of thanking Mr. Alexander for the work he had done this year in order to make the Show at Cardiff as great a success as possible. No man could have worked harder than he did, and if they were unfortunately not able to make the Show a financial success, it was certainly no fault of his. He also appreciated what Major Hansford had said, but he did not feel that any thanks were due to him, the fact being that he had enjoyed his year of office, which had brought him new friends and new interests, and, as he had already said, although he was relinquishing his high office that day, he hoped to be able to associate himself still with the work of that great Society.

The proceedings then terminated.

Royal Agricultural Society of England.

AWARDS OF PRIZES

AT

CARDIFF, 1938.

ABBREVIATIONS.

R.N., Reserve Number. H.C., Highly Commended. C., Commended.

HORSES.

Shires.

No. 1.—Shire Horse Society's Champion Gold Medal for best Stallion to JAMES FORSHAW & SONS' **Coleshill Field Marshal.**
No. 8.—R.N. for Champion Gold Medal to J. MORRIS BELCHER'S **Wootton Mimic.**
No. 45.—Shire Horse Society's Champion Gold Medal for best Mare or Filly to JAMES GOULD'S **Lymm Lady Grey.**
No. 51.—R.N. for Champion Gold Medal to WILLIAM MILNER'S **Wenlock Rosebud.**

Class 1.—*Shire Stallion, born in* 1935.

1st, £20. No. 1.—JAMES FORSHAW & SONS, Carlton-on-Trent, Newark, **Coleshill Field Marshal 42252.**
2nd, £10. No. 3.—A. THOMAS LOYD, Lockinge House, Wantage, **Tring Harvester 42799.**
3rd, £5. No. 6.—E. W. WEBB, Wickham Lodge, Cooden Drive, Bexhill-on-Sea, **Culcliffe Mimic 42261.**

Class 2.—*Shire Stallion, born in* 1936.

1st, £20. No. 8.—J. MORRIS BELCHER, Tibberton Manor, Wellington, Shropshire, **Wootton Mimic 42914.**
2nd, £10. No. 12.—JAMES GOULD, Crouchley Hall, Lymm, Cheshire, **Lymm Grey Friar 42706.**
3rd, £5. No. 11.—JAMES FORSHAW & SONS, Carlton-on-Trent, Newark, **Radio King 42744.**
R.N. No. 13.—WILLIAM MILNER, Callaughton, Much Wenlock, Shropshire, **Wenlock Broadcaster.**
H.C. No. 15.

Class 3.—*Shire Stallion, born in* 1937.

1st, £20. No. 22.—A. THOMAS LOYD, Lockinge House, Wantage, **Lockinge Minstrel.**
2nd, £10. No. 19.—JAMES GOULD, Crouchley Hall, Lymm, Cheshire, **Lymm Coming King.**
3rd, £5. No. 24.—SIR ERNEST S. WILLS, Bt., Littlecote, Hungerford, **Littlecote Prince William.**
4th, £4. No. 21.—THOMAS HELME, Wharton Court, Leominster, **Wharton Champion's Goldfinder.**

Class 4.—*Shire Gelding (by registered sire), born in or before* 1935.*

1st, £20. No. 25.—G. T. BEAL, Great Kendale, Driffield, Yorks., **Kendale Medlar.**
2nd, £15. No. 32.—MANN, CROSSMAN & PAULIN, LTD., Albion Brewery, Whitechapel Road, London, E.1, **Scarborough.**
3rd, £10. No. 34.—MANN, CROSSMAN & PAULIN. LTD., Whitechapel Road, **Silver Fox.**
4th, £5. No. 38.—YOUNG & CO.'S BREWERY, LTD., Ram Brewery, Wandsworth, S.W.18, **Wandle Bowler.**
5th, £5. No. 27.—ARTHUR V. CRUTCHLEY, 71, Price Street, Birkenhead, **Prince Victor 2nd.**
R.N. No. 26.—F. R. BEVAN, Lower House, Canon Froome, Ledbury, **Froome Victor.**
H.C. Nos. 35, 31.

* Prizes offered by the Shire Horse Society.

Class 5.—*Shire Mare (with her own Foal at foot).*

1st, £20. No. 40.—WILLIAM R. LYKE, Lawton Bury, Leominster, 127815 **Lawton Bury Rose.**

Class 6.—*Shire Colt or Filly Foal, the produce of a Mare entered in Class* 5, *or of a Filly in Class* 8.*

1st, £10. No. 42.—WILLIAM R. LYKE, Lawton Bury, Leominster, *d.* 127815 Lawton Bury Rose.
2nd, £5. No. 44.—G. C. WADSWORTH, Pandy Farm, St. Mellons, Mon., *d.* 128905 Mettingham Lady Lindy.

Class 7.—*Shire Mare, born in or before* 1934, *not having a foal at foot. A Mare* 6 *years old or over must have produced a live foal in* 1937 *or* 1938.*

1st, £15. No. 45.—JAMES GOULD, Crouchley Hall, Lymm, Cheshire, 126214 **Lymm Lady Grey.**
2nd, £10. No. 47.—G. C. WADSWORTH, Pandy Farm, St. Mellons, Mon., 126415 **Berrywood Forest Queen.**

Class 8.—*Shire Filly, born in* 1935.

1st, £20. No. 51.—WILLIAM MILNER, Callaughton, Much Wenlock, Shropshire, 129277 **Wenlock Rosebud.**
2nd, £10. No. 49.—JAMES B. BROWN, Woodland House, Sturton-le-Steeple, Retford, 128927 **Moretaine Marina.**
3rd, £5. No. 53.—G. C. WADSWORTH, Pandy Farm, St. Mellons, Mon., 128905 **Mettingham Lady Lindy.**

Class 9.—*Shire Filly, born in* 1936.

1st, £20, No. 56.—W. J. THOMPSON, Croyland, Woodham Road, Woking, 129544 **Chenies Mavis.**
2nd, £10. No. 59.—SIR ERNEST S. WILLS, Bt., Littlecote, Hungerford, 129945 **Littlecote Empress.**
3rd, £5. No. 54.—JAMES B. BROWN, Woodland House, Sturton-le-Steeple, Retford, 130256 **Sturton Champion Mistress.**
R.N. No. 57.—G. C. WADSWORTH, Pandy Farm, St. Mellons, Mon., 130107 **Paunceford Harboro' Princess.**

Class 10.—*Shire Filly, born in* 1937.

1st, £20. No. 66.—T. M. WATSON, Whinacre Park Drive, Blackpool, **Byre Bluebell.**
2nd, £10. No. 64. W. J. THOMPSON, Croyland, Woodham Road, Woking, **Heaton Lady.**
3rd, £5. No. 63.—WILLIAM MILNER, Callaughton, Much Wenlock, Shropshire, **Wenlock Queen Anne.**

Class 11.—*Team of Three or Four Shire Horses (Mares, Geldings or Mixed), in Harness with Vehicle.*

1st, £35. No. 69.—MANN, CROSSMAN & PAULIN, LTD., Albion Brewery, Whitechapel Road, London, E.1. Team of Four Grey Geldings.
2nd, £30. No. 70.—YOUNG & CO.'S BREWERY, LTD., The Ram Brewery, Wandsworth, S.W.18. Team of Four Black Geldings.
3rd., £25. No. 68.—WM. HANCOCK & CO., LTD., The Brewery, Cardiff. Team of Four Bay Geldings.
R.N. No. 67.—WM. HANCOCK & CO., LTD., The Brewery, Cardiff. Team of Four Brown Geldings.

Clydesdales.

No. 77.—Clydesdale Horse Society's Champion Silver Medal for best Stallion to T. & M. TEMPLETON'S **Mandate.**
No. 78.—R.N. for Champion Silver Medal to T. & M. TEMPLETON'S **Mid-day Sun.**
No. 93.—Clydesdale Horse Society's Champion Silver Medal for best Mare or Filly to GEORGE M. BECK'S **Remember Me.**
No. 92.—R.N. for Champion Silver Medal to GEORGE M. BECK'S **Glamour Girl.**

Class 12.—*Clydesdale Stallion, born in* 1936.

1st, £20. No. 72.—JOHN KERR, Redhall, Wigton, Cumberland, **Cumberland Grenadier.**
2nd, £10. No. 74. T. & M. TEMPLETON, Sandyknowe, Kelso, **Golden Banker** 23143.

* Prizes offered by the Shire Horse Society.

Class 13.—*Clydesdale Stallion, born in* 1937.

1st, £20. No. 77.—T. & M. Templeton, Sandyknowe, Kelso, **Mandate.**
2nd, £10. No. 78.—T. & M. Templeton, Sandyknowe, **Mid-day Sun.**

Class 14.—*Clydesdale Gelding (by registered sire), born in or before* 1935.*

1st, £20. No. 80.—Messrs. Greig, Housenrigg, Brayton, Aspatria, **Sir James.**
2nd, £10. No. 83.—Wyndham T. Vint, Thorn Cottage, Wroot, Doncaster, **Harry.**
3rd, £5. No. 82.—Messrs. Greig, Housenrigg, Brayton, Aspatria, **Sir John.**

Class 15.—*Clydesdale Mare (not having a foal at foot) or Filly, born in or before* 1935. *A Mare* 6 *years old or over must have produced a live foal in* 1937 *or* 1938.

[No. Exhibit.]

Class 16.—*Clydesdale Filly, born in* 1936.

1st, £20. No. 93.—George M. Beck, Fremington, Brougham, Penrith, **Remember Me.**
2nd, £10. No. 92.—George M. Beck, Brougham, **Glamour Girl.**

Suffolks.

No. 110. "Coronation" Challenge Cup for best Stallion to F. Newton Pratt's **Monarch of Morston.**
No. 100. R.N. for "Coronation" Challenge Cup to R. H. & R. Paul's **Broxtead Vanguard.**
No. 179. Suffolk Horse Society's Champion Prize of £10 for best Mare or Filly to Frank Sainsbury's **Wratting Sapphire.**
No. 144. R.N. for Champion Prize to P. Adams & Sons' **Laurel Golden Girl.**

Class 17.—*Suffolk Stallion, born in or before* 1934.†

1st, £20. No. 100.—R. H. & R. Paul, Broxtead, Sutton, Woodbridge, **Broxtead Vanguard** 6303.
2nd, £10. No. 97.—H. Ernest Holman, The Belt, Aylsham, Norwich, **Trapeze of Cockfield** 6416.
3rd, £5. No. 104.—Stuart Paul, Kirton Lodge, Ipswich, **Woolverstone Eclipse** 6207.
R.N. No. 107. Dennis Walker, Trowse, Norwich, **Wyverstone Monarch** 6508.
H.C. Nos. 105. **C.** Nos. 95, 99, 102.

Class 18.—*Suffolk Stallion, born in* 1935.

1st, £20. No. 110. F. Newton Pratt, Morston Hall, Trimley, Ipswich, **Monarch of Morston** 6696.
2nd, £10. No. 108.—P. Adams & Sons, Laurel Farm, Felixstowe, **Samford Ringleader** 6559.
3rd, £5. No. 109.—E. S. Buck & Son, Sycamore Farm, Ravenham, Norwich, **Beau Brocade of Ravenham** 6587.
R.N. No. 111.—Sir Cuthbert Quilter, Bt., Bawdsey, Woodbridge, **Bawdsey Mandarin** 6579.
H.C. No. 113.

Class 19.—*Suffolk Stallion, born in* 1936.

1st, £20. No. 121.—Frank Sainsbury, Blunts Hall, Little Wratting, Haverhill, **Wratting Beaumont** 6692.
2nd, £10. No. 115.—G. & R. Blewitt, Boxted Hall Farms, Colchester, **Boxted King Hal** 6650.
3rd, £5. No. 124.—Dennis Walker, Trowse, Norwich, **Wigborough Sir Basil** 6643.
4th, £4. No. 118.—R. H. & R. Paul, Broxtead, Sutton, Woodbridge, **Broxtead Julius** 6670.
R.N. No. 125.—Fred Walker, Broadmead, Burstow, Horley, Surrey, **Furnival Facet** 6654.
H.C. No. 123. **C.** No. 126.

Class 20.—*Suffolk Stallion, born in* 1937.

1st. £20. No. 129. T. J. Bailey, Hill Farm, Roxwell, Essex, **Roxwell Gold Cup** 6788.
2nd, £10. No. 128.—P. Adams & Sons, Laurel Farm, Felixstowe, **Laurel Windsor Lad** 6816.
3rd, £5. No. 130.—J. W. Bullard, Willingham Hall, Beccles, Suffolk, **Beccles Lord Foch** 6764.
R.N. No. 127.—His Majesty The King, Sandringham, Norfolk, **Sandringham Standard** 6868.
H.C. No. 131. **C.** Nos. 132, 133.

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* Prizes offered by the Clydesdale Horse Society.
† Prizes offered by the Suffolk Horse Society.

Class 21.—*Suffolk Gelding (by registered sire), born in or before* 1935.*

1st, £20. No. 142.—F. WARREN, Godbolts, Marks Tey, Essex, **Briton.**
2nd, £10. No. 137.—STUART PAUL, Kirton Lodge, Ipswich, **Captain.**
3rd, £5. No. 138.—STUART PAUL, Kirton Lodge, **Duke.**
4th, £4. No. 139.—STUART PAUL, Kirton Lodge, **Nelson.**
R.N. No. 135.—LT.-COL. F. G. G. BAILEY, Lake House, Salisbury, **Major.**
H.C. No. 141. **C.** No. 136.

Class 22.—*Suffolk Mare (with her own foal at foot).*

1st, £20. No. 144.—P. ADAMS & SONS, Laurel Farm, Felixstowe, **Laurel Golden Girl.** 17217.
2nd, £10. No. 150.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Elmah of Wratting** 16863.
3rd, £5. No. 149.—SIR S. HANSON ROWBOTHAM, Dunsbury Farm, Brook, Isle of Wight, **Pyrford Polly** 17704.
4th, £4. No. 156.—FRED WALKER, Broadmead, Burstow, Horely, Surrey, **Sutton Star** 16660.
R.N. No. 152.—E. BRAITHWAITE SAVORY, Warren Farm, Streatley, Reading, **Morston Bloom** 18001.
H.C. No. 146. **C.** Nos. 143, 154.

Class 23.—*Suffolk Colt Foal, produce of Mare in Class* 22 *or of a Filly in Class* 26.*

1st, £10. No. 161.—E. BRAITHWAITE SAVORY, Warren Farm, Streatley, Reading, *d.* Morston Bloom 18001.
2nd, £5. No. 157.—HIS MAJESTY THE KING, Sandringham, Norfolk, **Sandringham Saturn.**
3rd, £3. No. 158.—LT.-COL. F. G. G. BAILEY, Lake House, Salisbury, *d.* Clarendon Godiva 14932.
R.N. No. 162.—FRED WALKER, Broadmead, Burstow, Horley, Surrey, *d.* Sutton Star 16660.

Class 24.—*Suffolk Filly Foal, produce of Mare in Class* 22 *or of a Filly in Class* 26.*

1st, £10. No. 163.—P. ADAMS & SONS, Laurel Farm, Felixstowe, *d.* Laurel Golden Girl Girl 17217.
2nd, £5. No. 165.—EDWARD KAYLER, Shray Hill Farm, Willington, Shropshire, **Caprice of Shray Hill.**
3rd, £3. No. 167.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, *d.* Elmah of Wratting 16863.
R.N. No. 166.—SIR S. HANSON ROWBOTHAM, Dunsbury Farm, Brooke, Isle of Wight, *d.* Pyrford Polly 17704.
H.C. No. 168. **C.** No. 164.

Class 25.—*Suffolk Mare, born in or before* 1934, *not having a foal at foot. A Mare* 6 *years old or over must have produced a live foal in* 1937 *or* 1938.*

1st, £15. No. 170.—R. H. & R. PAUL, Broxtead, Sutton, Woodbridge, **Broxtead Julia** 16803.
2nd, £10. No. 169.—T. J. BAILEY, Hill Farm, Roxwell, Essex, **Roxwell Lady** 17538.
3rd, £5. No. 171.—SIR CUTHBERT QUILTER, BT., Bawdsey, Woodbridge, **BawdseyVirginia** 17339.

Class 26.—*Suffolk Filly, born in* 1935.

1st, £20. No. 179.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Sapphire** 18457.
2nd, £10. No. 180.—FRANK SAINSBURY, Blunts Hall, **Wratting Starlight** 18458.
3rd, £5. No. 181.—E. BRAITHWAITE SAVORY, Warren Farm, Streatley, Reading, **Symbo** 18731.
4th, £4. No. 177.—SIR S. HANSON ROWBOTHAM, Dunsbury Farm, Brooke, Isle of Wight, **Sennowe Snowdrop 2nd** 18711.
R.N. No. 182.—STRUTT & PARKER (FARMS), LTD., The Hill, Thorpe Morieux, Bury St. Edmunds, **Roundwood Bloom** 18316.
H.C. No. 173. **C.** No. 175.

Class 27.—*Suffolk Filly, born in* 1936.

1st, £20. No. 186.—STRUTT & PARKER (FARMS), LTD., The Hill, Thorpe Morieux, Bury St. Edmunds, **Thorpe Morieux Heather** 19080.
2nd, £10. No. 189.—F. WARREN, Godbolts, Marks Tey, Essex, **Godbolts Ann** 19056.

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* 1st, 2nd and 3rd Prizes offered by the Suffolk Horse Society.

3rd, £5. No. 188.—FRED WALKER, Broadmead, Burstow, Horley, Surrey, **Trim Maid** 18812.
R.N. No. 184.—SIR CUTHBERT QUILTER, BT., Bawdsey, Woodbridge, **Bawdsey Charm** 19168.
H.C. No. 185.

Class 28.—*Suffolk Filly, born in* 1937.

1st, £20. No. 191.—SIR S. HANSON ROWBOTHAM, Dunsbury Farm, Brooke, Isle of Wight, **Sennowe Scamp** 20099.
2nd, £10. No. 192.—E. BRAITHWAITE SAVORY, Warren Farm, Streatley, Reading, **Ridgeway Rambler** 19912.
3rd, £5. No. 190.—SIR S. HANSON ROWBOTHAM, Dunsbury Farm, Brooke, Isle of Wight, **Sennowe Sandy** 20098.

Class 29.—*Team of Three or Four Suffolk Horses (Mares, Geldings or Mixed,) in Harness, with Vehicle.*

1st, £35. No. 194.—STUART PAUL, Kirton Lodge, Ipswich. Team of Four Geldings.
2nd, £30. No. 193.—LT.-COL. F. G. G. BAILEY, Lake House, Salisbury. Team of Four Geldings.

Percherons.

Winners of Challenge Cups offered by the British Percheron Horse Society.

No. 209.—For best Stallion, born in Great Britain, to H. H. TRUMAN'S **Burrough Julius.**
No. 201.—R.N. to CHIVERS & SONS' **Histon Majestic.**
No. 232.—For best Filly, born in Great Britain, to CHIVERS & SONS' **Shenley Serverie.**
No. 239.—R.N. to CHIVERS & SONS' **Histon Regal Lady.**
No. 199.—For best Stallion to DUNCAN M. STEWART'S **Magister.**
No. 196.—R.N. to CHIVERS & SONS' **Lambert.**
No. 213.—For best Mare or Filly to CANEWDON FARM'S **Holme.**
No. 232.—R.N. to CHIVERS & SONS' **Shenley Serverie.**

Class 30.—*Percheron Stallion, born in or before* 1935.

1st, £20. No. 199.—DUNCAN M. STEWART, Millhills, Crieff, **Magister** B. 685.
2nd, £10. No. 196.—CHIVERS & SONS, LTD., Histon, Cambridge, **Lambert** B. 701.
3rd, £5. No. 197.—SYDNEY J. COLE, The Lodge, Winfarthing, Diss, **Stourhead Lagor 2nd** B. 555.
R.N. No. 195.—CANEWDON FARM, LTD., Scotts Hall, Canewdon, Essex, **Napoleon** B. 734.

Class 31.—*Percheron Stallion, born in* 1936.

1st, £20. No. 201.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Majestic** B. 721.
2nd, £10. No. 200.—CANEWDON FARM, LTD., Scotts Hall, Canewdon, Essex, **Oyama** B. 767.

Class 32.—*Percheron Stallion, born in* 1937.

1st, £20. No. 209.—H. H. TRUMAN, The Maze, March, Cambs., **Burrough Julius** B. 778.
2nd, £10. No. 206.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Radiant Lad** B. 782.
3rd, £5. No. 210.—H. H. TRUMAN, The Maze, March, Cambs., **Burrough Viking** B. 760.
R.N. No. 205.—CANEWDON FARM, LTD., Scotts Hall, Canewdon, Essex, **Panorama** B. 765.

Class 33.—*Percheron Gelding (by registered sire), born in or before* 1935.*

1st, £20. No. 211.—CHIVERS & SONS, LTD., Histon, Cambridge, **Majestic.**
2nd, £10. No. 212.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Aldenham Liberator** B. 517.

Class 34.—*Percheron Mare (with her own foal at foot).*

1st, £20. No. 213.—CANEWDON FARM, LTD., Scotts Hall, Canewdon, Essex, **Holme** B. 1477
2nd, £10. No. 215.—CHIVERS & SONS, LTD., Histon, Cambridge, **Iodee** B. 1171.
3rd, £5. No. 216.—THOMAS COOK, Hobland House, Bradwell, Great Yarmouth, **Louvette** B. 1296.
R.N. No. 220.—MRS. GRAHAM REES-MOGG, Clifford Manor, Stratford-on-Avon, **Nina** B. 1398.

Class 35.—*Percheron Colt or Filly Foal, produce of Mare in Class* 34.

1st, £10. No. 221.—CANEWDON FARM, LTD., Scotts Hall, Canewdon, Essex, *d.* Holme B. 1477.
2nd, £5. No. 227.—MRS. GRAHAM REES-MOGG, Clifford Manor, Stratford-on-Avon, *d.* Nina B. 1398.
3rd, £3. No. 223.—CHIVERS & SONS, LTD., Histon, Cambridge, *d.* Iodee B. 1171.
R.N. No. 224.—THOMAS COOK, Hobland House, Bradwell, Great Yarmouth, *d.* Louvette B. 1296.

* Prizes offered by the British Percheron Horse Society.

Class 36.—*Percheron Filly, born in* 1936.

1st, £20. No. 232.—Chivers & Sons, Ltd., Histon, Cambridge, **Shenley Serverie** B. 1462
2nd, £10. No. 235.—Thomas Cook, Hobland House, Hobland, Great Yarmouth, **Ocarina** B. 1541.
3rd, £5. No. 231.—Chivers & Sons, Ltd., Histon, Cambridge, **Histon Bright Star 2nd** B. 1454.
R.N. No. 230.—Canewdon Farm, Ltd., Scotts Hall, Canewdon, Essex, **Olga** B. 1545.

Class 37.—*Percheron Filly, born in* 1937.*

1st, £20. No. 239.—Chivers & Sons, Ltd., Histon, Cambridge, **Histon Regal Lady** B. 1604.
2nd, £10. No. 242.—Col. C. J. H. Wheatley, Berkswell Hall, Coventry, **Berkswell Petronella** B. 1502.
3rd, £5. No. 238.—Canewdon Farm, Ltd., Scotts Hall, Canewdon, Essex, **Elswick Pearl** B. 1583.
R.N. No .240.—Sydney J. Cole, The Lodge, Winfarthing, Diss, **Heywood Molly** B. 1586.

Class 38.—*Team of Three or Four Percheron Horses (Stallions, Mares, Geldings or Mixed), in Harness with Vehicle.*

[No Entry.]

Hunters.

No. 286.—Hunters' Improvement and National Light Horse Breeding Societys' Champion Gold Medal for best Mare to John Edward Jones' **Gilby.**
No. 284.—R.N. for Champion Gold Medal to A. J. Crewdson's **Belvedere Queen.**
No. 268.—Hunters' Improvement and National Light Horse Breeding Society's Champion Gold Medal for best Filly to Ian C. G. Scott's **Travel Alone.**
No. 269.—R.N. for Champion Gold Medal to Lord Stavordale's **Orthodox.**
No. 249.—Challenge Cup for best Young Hunter to Mrs. Howard Mander's **Demas.**
No. 268.—R.N. for Challenge Cup to Ian C. G. Scott's **Travel Alone.**

Class 39.—*Hunter Gelding, born in* 1935.

1st, £20.—No. 249.—Mrs. Howard Mander, Trysull Manor, Wolverhampton, **Demas** (Supp. No. 2241).
2nd, £10. No. 245.—Frederick H. D. Courtney, Oxford Lodge, Bicester, **Rathkeale** (Supp. No. 2247).
3rd, £5. No. 246.—A. J. Crewdson, Burdocks, Fairford, Glos., **Knockgorne** (Supp. No. 2140).
R.N. No. 244.—Rex A. L. Cohen, Condover Hall, Shropshire, **Scotch Mist** (Supp. No. 2149).

Class 40.—*Hunter Gelding, born in* 1936.

1st, £20. No. 255.—Mrs. Howard Mander, Trysull Manor, Wolverhampton, **Mr. Rowland** (Supp. No. 2245).
2nd, £10. No. 250.—Capt. T. Colville, Sandywell Park, Andoversford, Glos., **Cross Bun.**
3rd, £5. No. 251.—Mrs. H. Frank, Saddlewood, Wotton-under-Edge, **Good Friday.**
R.N. No. 252.—J. R. Hindley, Moorlands, Blacko, Nelson, **Talisman** (Supp. No. 2219).

Class 41.—*Hunter Colt or Gelding, born in* 1937.

1st, £20. No. 258.—Major Gordon B. Foster, Leysthorpe, Oswaldkirk, York, **Gadfly.**
2nd, £10. No. 264.—Mrs. E. M. Vaughan, Blackladies, Brewood, Stafford, **Snapper.**
3rd, £5. No. 261.—Mrs. Howard Mander, Trysull Manor, Wolverhampton, **Bonfire.**
R.N. No. 263.—Lord Stavordale, Evershot, Dorset, **Saint George 2nd** (Supp. No. 2141).
H.C. No. 260.

Class 42.—*Hunter Filly, born in* 1935.

1st, £20. No. 268.—Ian C. G. Scott, Gattertop, Leominster, 8691 **Travel Alone.**
2nd, £10. No. 269.—Lord Stavordale, Evershot, Dorset, 8699 **Orthodox.**
3rd, £5. No. 266.—Major and Mrs. Rowden, Bromesberrow Court, Dymock, Glos., 9066 **Allamartin.**
R.N. No. 267.—Ian C. G. Scott, Gattertop, Leominster, 8600 **Mary Ann 3rd.**
H.C. No. 265.

Class 43.—*Hunter Filly, born in* 1936.

1st, £20. No. 272.—Mrs. H. Frank, Saddlewood, Wotton-under-Edge, **Fisher Girl.**
2nd, £10. No. 277.—Lady Yule, Hanstead House, Bricket Wood, St. Albans, 8975 **Monclaire.**
3rd, £5. No. 275.—Mrs. E. M. Vaughan, Blackladies, Brewood, Stafford, **Roselet.**
R.N. No. 274.—Lord Stavordale, Evershot, Dorset, 8954 **Dolomite.**
H.C. No. 273.

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* Prizes offered by the British Percheron Horse Society.

Class 44.—*Hunter Filly, born in* 1937.

1st, £20. No. 283.—LADY YULE, Hanstead House, Bricket Wood, St. Albans, **Bayonne.**
2nd, £10. No. 279.—MORGAN T. JONES, Sugwas Court Farm, Swainshill, Hereford, **Sunshine.**
3rd, £5. No. 280.—F. G. Mathwin, Brooklea, Lesvane, Cardiff, **Skitby.**

Class 45.—*Hunter Mare (Novice) (with her own foal at foot).*

1st, £20. No. 286.—JOHN EDWARD JONES, Treworgan, Llangrove, Hereford, **7123 Gilby.**
2nd, £10. No. 284.—A. J. CREWDSON, Burdocks, Fairford, Glos., **Belvedere Queen.**
3rd, £5. No. 287.—MRS. E. M. VAUGHAN, Blackladies, Brewood, Stafford, **7406 Goldmint.**

Class 46.—*Hunter Mare (with her own foal at foot).*

1st, £20. No. 286.—JOHN EDWARD JONES, Treworgan, Llangrove, Hereford, **7123 Gilby.**
2nd, £10. No. 284.—A. J. CREWDSON, Burdocks, Fairford, Glos., **Belvedere Queen.**
3rd, £5. No. 287.—MRS. E. M. VAUGHAN, Blackladies, Brewood, Stafford, **7406 Goldmint.**

Class 47.—*Hunter Colt Foal, the produce of Mare in Classes* 45 *and* 46.

1st, £15. No. 291.—JOHN EDWARD JONES, Treworgan, Llangrove, Hereford, *d.* 7193 Gilby.
2nd, £10. No. 289.—A. J. CREWDSON, Burdocks, Fairford, Glos., *d.* Belvedere Queen.
3rd, £5. No. 292.—MRS. E. M. VAUGHAN, Blackladies, Brewood, Stafford, *d.* 7406 Goldmint.

Class 48.—*Hunter Filly Foal, produce of Mare in Classes* 45 *and* 46.

[No Exhibit.]

Special Produce Prizes for best groups of Young Hunters by same sire, to :—

Sired by LE PHARE.

1st. Nos. 276, 277, 283.—LADY YULE'S **Lotus, Monclaire** and **Bayonne.**

Sired by BRISL.

2nd. Nos. 260, 263, 274.—A. M. HOLMAN'S **Brigadier** and LORD STAVORDALE'S **Saint George 2nd,** and **Dolomite.**

Polo and Riding Ponies.

Winners of Medals offered by the National Pony Society :—

No. 298.—Champion Gold Medal for best Stallion or Colt to CAPT. W. H. FRANCE-HAYHURST'S **Grey Metal.**
No. 310.—R.N. for Champion Gold Medal to MRS. W. LINDSAY EVERARD'S **Kinloch.**
No. 321.—Champion Gold Medal for best Mare or Filly and R.N. for Bronze Medal for best Foal to MRS. CHAS. G. COE'S **Tea Rose.**
No. 316.—Champion Silver Medal for best Filly and R.N. for Champion Gold Medal for best Mare or Filly to the MISSES CADMADY-HAMLYN and DAWSON'S **Jemima.**
No. 315.—R.N. for Champion Silver Medal to H. BRIGHT'S **Silverdale Ruth.**
No. 323.—Bronze Medal for best Foal to CAPT. W. H. FRANCE-HAYHURST'S **Rosina.**

Class 49.—*Polo and Riding Pony Stallion, born in or before* 1935.

1st, £20, No. 298.—CAPT. W. H. FRANCE-HAYHURST, Bostock Hall, Middlewich, **Grey Metal** 1997.
2nd, £10. No. 300.—MRS. G. A. WRIGHT, Yelfords, Chagford, Devon, **Hitler** 2140.
3rd, £5. No. 294.—H. BRIGHT, The Cove, Silverdale, Carnforth, **Silverdale Tarragon** 1918.
R.N. No. 295.—MRS. CHAS. G. COE, Windlesham Hall, Windlesham, Surrey, **Falconeri** 2138.

Class 50.—*Polo and Riding Pony Colt, Filly or Gelding, born in* 1937.

1st, £20. No. 303.—MISS B. G. CORY-WRIGHT, The Golden Parsonage, Hemel Hempstead, **Hidden Eyrie** (Supp. 1928).
2nd, £10. No. 304.—MRS. W. LINDSAY EVERARD, Ratcliffe Hall, Leicestershire, **Ratcliffe Malaudrey** (Supp. 1937).
3rd, £5. No. 305.—MRS. W. LINDSAY EVERARD, Ratcliffe Hall, **Ratcliffe Surprise** (Supp. 1937).
R.N. No. 301.—MAJOR J. W. BISHOP, Llwynhelig, Llandilo, **Joker 2nd** (Y.S.R., p. 213).

Class 51.—*Polo and Riding Pony Colt, Filly or Gelding, born in* 1936.

1st, £20. No. 310.—MRS. W. LINDSAY EVERARD, Ratcliffe Hall, Leicestershire, **Kinlock** (Supp. 1936).

2nd, £10. No. 308.—H. BRIGHT, The Cover, Silverdale, Carnforth, **Silverdale Credenda** (Supp. 1936).
3rd, £5. No. 312.—CAPT. W. H. FRANCE-HAYHURST, Bostock Hall, Middlewich, **Coronation 2nd** (Supp. 1936).
R.N. No. 311.—MRS. W. LINDSAY EVERARD, Ratcliffe Hall, Leicestershire, **Kittiwake** (Supp. 1936).

Class 52.—*Polo and Riding Pony Filly or Gelding, born in* 1935.

1st, £20. No. 316.—MISSES CALMADY-HAMLYN & DAWSON, Little Bidlake, Bridestowe, Devon, **Jemima.** (Supp. 1935).
2nd, £10. No. 315.—H. BRIGHT, The Cove, Silverdale, Carnforth, **Silverdale Ruth** (Supp. 1935).
3rd, £5. No. 320.—**Mrs. J. Oscar Muntz,** Foxhams, Horrabridge, Devon, **Coming Light** (Supp. 1935).
R.N. No. 318.—CAPT. W. H. FRANCE-HAYHURST, Bostock Hall, Middlewich, **Corona 3rd** (Supp. 1935).

Class 53.—*Polo and Riding Pony Mare (with her own foal at foot).*

1st, £20. No. 321.—MRS. CHAS. G. COE, Windlesham Hall, Windlesham, Surrey, 7306 **Tea Rose.**
2nd, £10. No. 324.—MRS. J. OSCAR MUNZ, Foxhams, Horrabridge, Devon, 6037 **Stolen Love.**
3rd, £5. No. 323.—CAPT. W. H. FRANCE-HAYHURST, Bostock Hall, Middlewich, 6026 **Rosine.**
R.N. No. 325.—MRS. C. B. YOUNG, Huish, Basingstoke, 6646 **Wild Rose 3rd.**

Arabs.

No. 331.—Arab Horse Society's Champion Silver Medal for best Stallion or Colt to LADY YULE'S **Raktha.**
No. 333.—R.N. for Champion Silver Medal to LADY YULE'S **Riffal.**
No. 334.—Arab Horse Society's Silver Medal for best Filly to T. C. ARMITAGE'S **Algola.**
No. 338.—R.N. for Silver Medal to GEORGE RUXTON'S **Algoletta.**

Class 54.—*Arab Stallion, born in or before* 1934.*

1st, £15. No. 331.—LADY YULE, Hanstead House, Bricket Wood, St. Albans, **Raktha.**
2nd, £10. No. 328.—GEORGE RUXTON, Craven Lodge, Monk Sherborne, Basingstoke, **Algol** (Vol. 4, p. 23).
3rd, £5. No. 326.—MRS. E. M. MURRAY, Painswick Lodge, Painswick, Glos., **Sahban** (Vol. 5, p. 85).
R.N. No. 329.—LADY YULE, Hanstead House, Bricket Wood, St. Albans, **Grey Owl** (Vol. 5, p. 38).

Class 55.—*Arab Stallion or Colt, born in* 1935, 1936 *or* 1937.

1st, £15. No. 333.—LADY YULE, Hanstead House, Bricket Wood, St. Albans, **Riffal** (Vol. 5, p. 117).
2nd, £10. No. 332.—D. E. NEALE, Nant Fawr, Lisvane, Glam., **Rishan Tani** (Vol. 5, p. 81).

Class 56.—*Arab Filly, born in* 1935, 1936 *or* 1937.

1st, £15. No. 334.—T. C. ARMITAGE, Dene Court, Taunton, **Algola** (Vol. 5, p. 106).
2nd, £10. No. 338.—GEORGE RUXTON, Craven Lodge, Monk Sherborne, Basingstoke, **Algoletta** (Vol. 5, p. 107).
3rd, £5. No. 335.—T. C. ARMITAGE, Dene Court, Taunton, **Chocolate Cream** (Vol. 5, p. 122).
R.N. No. 339.—LADY YULE, Hanstead House, Bricket Wood, St. Albans, **Ariffa.**

Welsh Cobs, Welsh Ponies and Welsh Mountain Ponies.

£30 towards these Prizes are offered by the Welsh Pony and Cob Society.

Winners of Champion Silver Medals offered by the Welsh Pony and Cob Society :—

No. 350.—For best Welsh Cob Stallion or Colt to H. MEYRICK JONES' **Mathrafal.**
No. 341.—R.N. to D. O. MORGAN'S **Parc-Express.**
No. 344.—For best Welsh Cob Mare or Filly to J. D. EVANS' **Teify of Hercws.**
No. 343.—R.N. to MR. J. O. DAVIES' **Dewi Black Bess.**
No. 358.—For best Welsh Pony to JOSEPH LEWIS' **Myrtle Rosina.**
No. 352.—R.N. to MISS M. BRODRICK'S **Tan-y-Bwlch Prancio.**
No. 364.—For best Welsh Mountain Stallion or Colt to TOM JONES EVANS' **Grove Sprightly.**
No. 365.—R.N. to JOHN B. HOLDEN'S **Coed Coch Erlewyn.**
No. 372.—For best Welsh Mountain Mare or Filly to MATTHEW WILLIAMS' **Vardra Charm.**
No. 371.—R.N. to TOM JONES EVANS' **Gatesheath Dainty.**

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* Prizes offered by the Arab Horse Society.

Class 57.—*Welsh Cob Stallion, born in or before* 1935.

1st, £15. No. 341.—D. O. Morgan, Coedparc, Lampeter, **Parc-Express** 1623.

Class 58.—*Welsh Cob-Mare born in or before* 1934.

1st, £15. No. 344.—J. D. Evans, Dewi Well, Llanddewi, Brefi, Cards., 8929 **Teify of Hercws.**
2nd, £10. No. 343.—J. O. Davies, Pentrebrain, Llanddewi, Brefi, Cards., **Dewi Black Bess.**
3rd, £5. No. 346.—Gwilym M. Morris, Pistill, Llanfihangel, Talyllyn, **Pistill Nance.**
R.N. No. 342.—John Davies, Bwlchmawe, Llanwenog, Llanybyther, Cards., 88 F.S. **Lady Gwenog 6th.**

Class 59.—*Welsh Cob Filly or Gelding, born in* 1935, *or Colt, Filly or Gelding, born in* 1936.

1st, £15. No. 350.—H. Meyrick Jones, Mathrafal, Meifod, Mont, **Mathrafal** 1629.
2nd, £10. No. 349.—David J. Davies, Llwynrheol, Oakford, Llanarth, Cards., **Oakford Welsh Flyer** 1621.
3rd, £5. No. 351.—Thomas M. Thomas, Pantyrodyn, Beulah, Newcastle Emlyn, **Garibaldi Welsh Flyer.**
R.N. No. 348.—Cahn Hill Improvement Scheme, Pwllpeiran, Cwmystwyth, Aberystwyth, 14 **Cahn Scott.**

Class 60.—*Welsh Pony Mare of Riding type, born in or before* 1934. *A Mare* 6 *years old or over must have produced a live foal in* 1937 *or* 1938.

1st, £15. No. 352.—Miss M. Brodrick, Coed Côch, Abergele, 8895 **Tan-y-Bwlch Prancio.**
2nd, £10. No. 353.—Mrs. A. R. Hepburn, Orchard Road, Erdington, Birmingham, 8910 **Craven Nell.**
3rd, £5. No. 354.—Joseph Lewis, Blaendyffryn, Llandyssul, Cards., 9030 **Dyffryn Moonlight.**

Class 61.—*Welsh Pony Mare of Cob type. A Mare* 6 *years old or over must have produced a live foal in* 1937 *or* 1938.

1st, £15. No. 358.—Joseph Lewis, Blaendyffryn, Llandyssul, Cards., 8584 **Myrtle Rosina.**
2nd, £10. No. 357.—Peter Davies & Son, Brynteifi, Llanio Road, Cards., 8872 **Dew Pride.**
3rd, £5. No. 359.—Alfred L. Williams, Blaentwrch Farm, Lampeter, 8991 **Welsh Homage.**

Class 62.—*Welsh Pony Filly or Gelding of Riding type, born in* 1935, *or Colt, Filly or Gelding, of Riding type, born in* 1936.

1st, £15. No. 360.—Miss M. Brodrick, Coed Côch, Abergele, **Tan-y-Bwlch Pensarn.**
2nd, £10. No. 362.—Matthew Williams, Brynheulog, Tonteg, Llantwit Vardra, Gla., 92 F.S. **Vardra Moonshine.**
3rd, £5. No. 361.—Peter Davies & Son, Brynteifi, Llanio Road, Cards., **Teify Brightlight.**

Class 63.—*Welsh Mountain Pony Stallion, born in or before* 1935.

1st, £15. No. 364.—Tom Jones Evans, Dinchope Farm, Craven Arms, **Grove Sprightly** 1036.
2nd, £10. No. 365.—John B. Holden, Shimdda Hir, Llandudno, **Coed Côch Erlewyn** 1590.
3rd, £5. No. 366.—Mrs. R. H. V. Sivewright, Penn House, Bramshaw, Lyndhurst, Hants., **Bowdler Bright Light** 1303.
R.N. No. 363.—Miss M. Brodrick, Coed Côch, Abergele, **Coed Côch Glyndwr** 1617.

Class 64.—*Welsh Mountain Pony Colt or Gelding, born in* 1936 *or* 1937.

[No Entry.]

Class 65.—*Welsh Mountain Pony Mare, born in or before* 1935. *A Mare* 6 *years old or over must have produced a live foal in* 1937 *or* 1938.

1st, £15. No. 372.—Matthew Williams, Brynheulog, Tonteg, Llanwit Vardra, Glam., 8325 **Vardra Charm.**
2nd, £10. No. 371.—Tom Jones Evans, Dinchope Farm, Craven Arms, 8616 **Gatesheath Dainty**
3rd, £5. No. 368.—Miss M. Brodrick, Coed Côch, Abergele, 7347 **Grove Madcap.**

Class 66.—*Welsh Mountain Pony Filly, born in* 1936 *or* 1937.

1st, £15. No. 374.—Miss M. Brodrick, Coed Côch, Abergele, **Coed Côch Eurliw Goch.**

Class 67.—*Welsh Riding Pony, not exceeding* 13 *hands, shown under saddle, registered or eligible for registration in the Welsh Stud Book or entered or eligible for entry in the Appendix to the Stud Book.*

1st, £15. No. 352.—Miss M. Brodrick, Coed Côch, Abergele, 8895 **Tan-y-Bwlch Prancio.**
2nd, £10. No. 353.—Mrs. A. R. Hepburn, Orchard Road, Erdington, Birmingham, 8910 **Craven Nell.**
3rd, £5. No. 376.—H. Meyrick Jones, Mathrafal, Meifod, Mont., **Mathrafal Nepeta.**
R.N. No. 377.—D. O. Morgan, Coedparc, Lampeter, **Shandy Gaff.**

Shetland Ponies.

No. 381.—Champion Silver Medal for best Shetland Pony to Mrs. E. M. Dick's **Bergastor of Transy.**
No. 379.—R.N. for Champion Silver Medal to Mrs. Maurice Cox's **Rustic Sprite of Standen.**

Class 68.—*Shetland Pony Stallion, not exceeding* 10½ *hands, born in or before* 1935.

1st, £15. No. 381.—Mrs. E. M. Dick, Transy, Dunfermline, **Bergastor of Transy** (Vol. 41, p. 55).
2nd, £10. No. 379.—Mrs. Maurice Cox, Marshwood Manor, Bridport, Dorset, **Rustic Sprite of Standen** 1343.
3rd, £5. No. 378.—Mrs. G. E. Atkinson, Felbridge Park, East Grinstead, **May Visier of Felbridge** 1347.
R.N. No. 380.—Mrs. Maurice Cox, Marshwood Manor, Bridport, Dorset, **Speaker of Marshwood** (Vol. 42, p. 28).

Class 69.—*Shetland Pony Mare, not exceeding* 10½ *hands, born in or before* 1935, *with or without foal at foot. A Mare* 5 *years old or over must have produced a live foal.*

1st, £15. No. 385.—Mrs. E. M. Dick, Transy, Dunfermline, 4446 **Maid of Kirkland.**
2nd, £10. No. 383.—Mrs. G. E. Atkinson, Felbridge Park, East Grinstead, 4393 **Peace of Colne.**
3rd, £5. No. 384. Mrs. Maurice Cox, Marshwood Manor, Bridport, Dorset, **Rose Blossom of Maryfield** (Vol. 39, p. 24).

Riding Classes.

Hunters.

No. 433.—Perpetual Silver Gilt Challenge Cup for best Mare or Gelding to J. R. Hindley's **Bradbury.**
No. 445.—R.N. for Silver Gilt Challenge Cup to John H. Betts' **Danno.**

Class 70.—*Hunter Mare or Gelding, born in* 1934.

1st, £15. No. 409.—Thomas L. Parke, Withnell Fold Hall, Chorley, Lancs., **Blunderer's Pride.**
2nd, £10. No. 412.—J. V. Rank, Ouborough, Godstone, Surrey, **Insolent.**
3rd, £5. No. 405.—A. J. Crewdson, Burdocks, Fairford, Glos., **Whitegate.**
4th, £3. No. 406.—H. Dyke-Dennis, New Hall, Ruabon, **Monarch.**
R.N. No. 410.—The Duchess of Norfolk, Arundel Castle, Sussex, **Fire Fly 2nd.**
H.C. No. 408. **C.** No. 400.

Class 71.—*Hunter Mare or Gelding (Novice), born in or before* 1934, *up to from* 12 *to* 14 *stone.*

1st, £15. No. 413.—J. V. Rank, Ouborough, Godstone, Surrey, **Snob.**
2nd, £10. No. 435.—Lady Dorothy Lygon, Madresfield Court, Malvern, **Philip.**
3rd, £5. No. 434.—John Edward Jones, Treworgan, Llangrove, Hereford, **Cavalcade.**
4th, £3. No. 405.—A. J. Crewdson, Burdocks, Fairford, Glos., **Whitegate.**
R.N. No. 410. The Duchess of Norfolk, Arundel Castle, Sussex, **Fire Fly 2nd.**
H.C. 408.

Class 72.—*Hunter Mare or Gelding (Novice), born in or before* 1934, *over* 14 *stone.*

1st, £15. No. 414.—J. V. Rank, Ouborough, Godstone, Surrey, **The Curate.**
2nd, £10. No. 409.—Thomas L. Parke, Withnell Fold Hall, Chorley, Lancs., **Blunderer's Pride.**
3rd, £5. No. 444.—C. R. Harris, The Stud Farm, Coedkernew, Newport, Mon., **Hunty Lodge.**
4th, £3. No. 406.—H. Dyke-Dennis, New Hall, Ruabon, **Monarch.**
R.N. No. 427.—Mrs. R. T. Whitehead, Bryn Rhydderch, Abergavenny, **Darrington.**

Class 73.—*Hunter Mare or Gelding, born in or before* 1933, *up to not more than* 14 *stone, suitable to carry a Lady, and to be ridden by a Lady (side-saddle).*

1st, £15. No. 415.—J. V. RANK, Ouborough, Godstone, Surrey, **Guilsborough.**
2nd, £10. No. 445.—JOHN H. BETTS, Compton House, Kinver, Worcs., **Danno.**
3rd, £5. No. 434.—JOHN EDWARD JONES, Treworgan, Llangrove, Hereford, **Cavalcade.**
4th, £3. No. 435.—LADY DOROTHY LYGON, Madresfield Court, Malvern, **Philip.**

Class 74.—*Hunter Mare or Gelding, born in or before* 1934, *up to not more than* 13 *stone.*

1st, £20. No. 413.—J. V. RANK, Ouborough, Godstone, Surrey, **Snob.**
2nd, £15. No. 434.—JOHN EDWARD JONES, Treworgan, Llangrove, Hereford. **Cavalcade.**
3rd, £10. No. 407.—H. DYKE-DENNIS, New Hall, Ruabon, **Pat-a-Cake.**
4th, £5. No. 449.—W. H. C. DANIEL, Alltyferin, Nantgaredig, Carm., **Drambuie.**

Class 75.—*Hunter Mare or Gelding, born in or before* 1934, *over* 13 *stone and not more than* 14 *stone* 7 *lb.*

1st, £20. No. 433.—J. R. HINDLEY, Moorlands, Black, Nelson, Lancs., **Bradbury.**
2nd, £15. No. 445.—JOHN H. BETTS, Compton House, Kinver, Worcs., **Danno.**
3rd, £10. No. 415.—J. V. RANK, Ouborough, Godstone, Surrey, **Guilsborough.**
4th, £5. No. 435.—LADY DOROTHY LYGON, Madresfield Court, Malvern, **Philip.**
5th, £3. No. 407.—H. DYKE-DENNIS, New Hall, Ruabon, **Pat-a-Cake.**
R.N. No. 440.—HUGH SUMNER, Rashwood Court, Droitwich, **Loyalist.**
H.C. No. 438.

Class 76.—*Hunter Mare or Gelding, born in or before* 1934, *over* 14 *stone* 7 *lb.*

1st. £20. No. 414.—J. V. RANK, Ouborough, Godstone, Surrey, **The Curate.**
2nd, £15. No. 444.—C. R. HARRIS, The Stud Farm, Coedkernew, Newport, Mon., **Hunty Lodge.**

Weight-Carrying Cobs.

No. 346.—Welsh Pony and Cob Society's Silver Medal for the best Welsh Cob to GWILYM M. MORRIS' **Pistill Nance.**

Class 77.—*Weight-Carrying Cob, Mare or Gelding, not exceeding* 15·1 *hands and to carry not less than* 15 *stone.*

1st, £15. No. 446.—R. MORTON PEEL, Willoughby House, Rugby, **Mr. Sponge.**
2nd, £10. No. 404.—FREDERICK H. D. COURTNEY, Oxford Lodge, Bicester, **The Odd Spot.**
3rd, £5. No. 453.—MRS. C. H. MAYNARD, Trefedrid, Meifod, Mont., **Splash.**
4th, £3. No. 454.—D. E. NEALE, Nant Fawr, Lisvane, Glam., **Gipsy.**
R.N. No. 346. GWILYM M. MORRIS, Pistill, Llanfrhangel Talyllyn, **Pistill Nance.**

Hacks.

No. 468.—Silver Challenge Cup for best Hack to MRS. A. SIMMONS' **Iron Duke.**
No. 455.—R.N. for Challenge Cup to MISS SHEILA SPOONERS' **Aphrodite.**

Class 78.—*Hack Mare or Gelding, not exceeding* 15 *hands.*

1st, £10. No. 455.—MISS SHIELA SPOONER, Hill Crest, Foley Road, Streetly, Staffs., **Aphrodite.**
2nd, £5. No. 459.—MISS DORIS STEPHENS, Broomhill, Kidwelly, Carm., **Predicament.**
3rd, £3. No. 460.—CAPT. JOHN TEMPLETON, Maes-y-llech, Radyr, Cardiff, **Sailor.**

Class 79.—*Hack Mare or Gelding, over* 15 *hands.*

1st £10. No. 468.—MRS. A. SIMMONS, Broomy Close, Wormelow, Hereford, **Iron Duke.**
2nd, £5. No. 467.—MISS DOROTHY RAMSDEN, The Grove, Peterstow, Ross-on-Wye, **Seachest.**
3rd, £3. No. 466.—MISS DOROTHY RAMSDEN, Peterstow, **John Silver.**
4th, £2. No. 469.—MRS. R. T. WHITEHEAD, Bryn Rhydderch, Abergavenny, **Pardon Me.**
5th, £1. No. 464.—MISS BETTY LLEWELLYN, St. Fagans Court, Glam., **Maza.**
R.N. No. 458.—MISS PAMELA ROWE, Windrush, Burford, Oxon., **Feuiller.**

Children's Ponies.

Class 80.—*Pony Mare or Gelding, not exceeding* 12·2 *hands. To be ridden by a child who has not attained his or her* 11*th birthday on the* 8*th July,* 1938.

1st, £10. No. 478.—S. H. Brookshaw, Aychley, Market Drayton, **Cream Cracker.**
2nd, £5. No. 480.—Neville Budgen, Llandaff, Glam., **June.**
3rd, £3. No. 353.—Mrs. A. R. Hepburn, Orchard Road, Erdington, Birmingham, 8910 **Craven Nell.**
4th, £2. No. 484.—Thomas Jenkins, Lynwood, Pontyclun, Glam., **The Dawn.**
5th, £1. No. 489.—Matthew Williams, Brynheulog, Tonteg, Llantwit Vardre, Glam., **Silver Mint.**
H.C. Nos. 352, 377, 482.

Class 81.—*Pony Mare or Gelding, over* 12·2 *and not exceeding* 13·2 *hands. To be ridden by a child who has not attained his or her* 14*th birthday on the* 8*th July,* 1938.

1st, £10. No. 476.—William Benson, Harrowby Fields, Grantham, **Goldfinder.**
2nd, £5. No. 490.—Miss Shirley Burton, Hazon House, Epsom, Surrey, **Gold Piece.**
3rd, £3. No. 479.—S. H. Brookshaw, Aychley, Market Drayton, **Sweet Surprise.**
4th, £2. No. 485.—Thomas Jenkins, Lynwood, Pontyclun, Glam., **The Gent.**
5th, £1. No. 376.—H. Meyrick Jones, Mathrafal, Meifod, Mont., **Mathrafal Nepeta.**

Class 82.—*Pony Mare or Gelding, over* 13·2 *and not exceeding* 14·2 *hands. To be ridden by a child who has not attained his or her* 16*th birthday on the* 8*th July,* 1938

1st, £10. No. 477.—William Benson, Harrowby Fields, Grantham, **Tabarina.**
2nd, £5. No. 498.—Mrs. Joan Nelson, 30, West Hill, Epsom, Surrey, **Love Knot.**
3rd, £3. No. 496.—Frederick H. D. Courtney, Oxford Lodge, Bicester, **Hazel Witch.**
4th, £2. No. 481.—Neville Budgen, Llandaff, Glam., **Roseleaf.**
5th, £1. No. 483.—Frederick Devereux, Riding School, Llanishen, Glam., **Geisha.**

Driving Classes.

Single Harness.

No. 503.—Champion Prize of **£20** for the best Animal not exceeding 14 hands to Mr. & Mrs. Walter Briggs' **Barcroft Belle.**
No. 529.—R.N. **£10** for Champion Prize to Nigel C. Colman's **Cassilis High and Mighty.**
No. 530.—Vice-President's Challenge Cup for the best Animal and Champion Prize of **£20** for the best Animal over 14 hands to Nigel C. Colman's **Nork Spotlight.**
No. 520.—R.N. for the President's Challenge Cup and R.N. **£10** for Champion Prize to Claude F. Goddard's **Erlegh Paramount.**

Class 83.—*Harness Stallion, Mare or Gelding* (*Novice*) *not exceeding* 14 *hands.*

1st, £15. No. 515.—William Lawson, Greenhill, Paisley, **Georgie Wood.**
2nd, £10. No. 522.—J. C. Sword, Craigweil, Ayr, **Wensleydale Mascot.**
3rd, £5. No. 504.—Mrs. Edgar Henriques, Fernholm, Hesketh Park, Southport, **Fleetwood Snowstorm.**
H.C. Nos. 517, 518.

Class 84.—*Harness Stallion, Mare or Gelding* (*Novice*), *over* 14 *hands.*

1st, £15. No. 520.—Claude F. Goddard, Holywell Park, Wrotham, Kent, **Erlegh Paramount.**
2nd, £10. No. 542.—J. W. G. Smith, Wensleydale Stud, Aysgarth, Yorks., **Wensleydale Wildfire** G. 987.
3rd, £5. No. 501.—Mr. and Mrs. Walter Briggs, Linden Hall, Borwick, Carnforth, 27230 **Albin Lady Nina.**

Class 85.—*Harness Stallion, Mare or Gelding, not exceeding* 13·2 *hands.*

1st, £15. No. 503.—Mr. and Mrs. Walter Briggs, Linden Hall, Borwick, Carnforth, 26769 **Barcroft Belle.**
2nd, £10. No. 529.—Nigel C. Colman, M.P., 49, Grosvenor Square, London, W.1, 26923 **Cassilis High and Mighty.**
3rd, £5. No. 523.—J. C. Sword, Craigweil, Ayr, **Habrough Wattie.**
R.N. No. 515.—William Lawson, Greenhill, Paisley, **Georgie Wood.**

Class 86.—*Harness Stallion, Mare or Gelding, over* 13·2 *and not exceeding* 14 *hands.*

1st, £15. No. 537.—Frank C. Minoprio, Broadlands, Ascot, **Mickey Mouse G. 737.**
2nd, £10. No. 532.—Paul Hoffmann, 4, Cardigan Mansions, Richmond Hill, Surrey, **26895 Oxford Caprice.**
3rd, £5. No. 518.—J. W. G. Smith, Wensleydale Stud, Aysgarth, Yorks., **Wensleydale Viscount.**
R.N. No. 507.—Mrs. Edgar Henriques, Fernholm, Hesketh Park, Southport, **Fleetwood Live Fuse.**

Class 87.—*Harness Stallion, Mare or Gelding, over* 14 *and not exceeding* 15 *hands.*

1st, £15. No. 530.—Nigel C. Colman, M.P., 49, Grosvenor Square, London, W.1. **Nork Spotlight 14747.**
2nd, £10. No. 508.—Mrs. Edgar Henriques, Fernholm, Hesketh Park, Southport, **Fleetwood Nanette.**
3rd, £5. No. 501.—Mr. and Mrs. Walter Briggs, Linden Hall, Borwick, Carnforth, **Albin Lady Nina.**
R.N. No. 533. Paul Hoffman, 4, Cardigan Mansions, Richmond Hill, Surrey. **26692 Modern Miss.**
H.C. No. 541.

Class 88.—*Harness Stallion, Mare or Gelding over* 15 *hands.*

1st, £15. No. 525.—J. C. Sword, Craigweil, Ayr, **Kentmere Searchlight.**
2nd, £10. No. 543.—Claud F. Goddard, Holywell Park, Wrotham, Kent, **Holywell Squire G. 863.**
3rd, £5. No. 539.—F. C. Minoprio, Broadlands, Ascot, **Pollux G. 775.**
R.N. No. 516.—William Lawson, Greenhill, Paisley, **Crack o' the Whip.**
H.C. Nos. 521, 535.

Double Harness.

Class 89.—*Pair of Stallions, Mares or Geldings, not exceeding* 14 *hands.*

1st, £15. Nos. 537, 540.—F. C. Minoprio, Broadlands, Ascot, **Mickey Mouse** and **King of the Lawn G. 893.**
2nd, £10. Nos. 522, 523.—J. C. Sword, Graigweil, Ayr, **Wensleydale Mascot** and **Habrough Wattie.**

Class 90.—*Pair of Stallions, Mares or Geldings, over* 14 *hands.*

1st, £15. No. 520, 521.—Claud F. Goddard, Holywell Park, Wrotham, Kent, **Erlegh Paramount** and **Gay Hussar.**
2nd, £10. Nos. 508, 513.—**Mrs. Edgar Henriques**, Fernholm, Hesketh Park, Southport, **Fleetwood Nanette** and **Fleetwood Courrency.**
3rd, £5. Nos. 535, 536.—Paul Hoffmann, 4, Cardigan Mansions, Richmond Hill, Surrey, **Orford Victor 143770** and **26550 Orford Gavotte.**

Tandem.

Class 91.—*Tandem, Stallions, Mares or Geldings, not exceeding* 14 *hands.*

1st, £15. Nos. 537, 540.—F. C. Minoprio, Broadlands, Ascot, **Mickey Mouse** and **King of the Lawn G. 893.**
2nd, £10. Nos. 522, 523.—J. C. Sword, Craigweil, Ayr, **Wensleydale Mascot** and **Habrough Wattie.**

Class 92.—*Tandem, Stallions, Mares or Geldings, over* 14 *hands.*

1st, £15, Nos. 508, 513.—Mrs. Edgar Henriques, Fernholm, Hesketh Park, Southport, **Fleetwood Nanette** and **Fleetwood Courrency.**
2nd, £10. Nos. 520, 521.—Claud F. Goddard, Holywell Park, Wrotham, Kent, **Erlegh Paramount** and **Gay Hussar.**
3rd, £5. Nos. 535, 536.—Paul Hoffmann, 4, Cardigan Mansions, Richmond Hill, Surrey. **Orford Victor 14370,** and **26550 Orford Gavotte.**

Horse Jumping Competitions.

Class A.—*Mare or Gelding.*

1st, £20; 2nd, £15; 3rd, £10; 4th, £5; 5th, £3, 6th, £3 (divide). No. 5—F. W. Foster, Friary Farm, Etwall, Derby, **It**; No. 8—Joseph Taylor, Moss Hall, Stretton, Warrington, **Exchange**, No. 23, **Knut**; No. 33, **Jorrocks**; No. 25—Thomas Makin, Newton Farm, Castleford, Yorks., **Crackle**; No. 27—E. Adcock, The Grange, Thurmaston, Leicester, **Pola**; No. 36—S. W. Woodhall, Mount Pleasant, Wellington, Shropshire, **Brimstone.**

Class B.—*Mare or Gelding.*

1st and 2nd, £15 (divide); No. 18—F. W. FOSTER, Friary Farm, Etwall, Derby, **Huntsman**: No. 28—JOSEPH TAYLOR, Moss Hall, Stretton, Warrington, **Exchange.**

3rd, £10: 4th, £5; 5th, £3, 6th, £3 (divide). No. 1—F. W. FOSTER, Friary Farm, Etwall, Derby, **Peter**; No. 5—S. W. WOODHALL, Mount Pleasant, Wellington, Shropshire, **Red Rufus**; No. 12—**Marina**; No. 9—E. ADCOCK, The Grange, Thurmaston, Leicester, **Sandy**; No. 13—A. H. Ashcroft, Riding School, Aughton, Ormskirk, **Speculation**; No. 25—ARTHUR BRAKE, Higher Farm, Limington, Yeovil, **Eclipse.**

Class C.—*Mare or Gelding.*

1st, £20. No. 32.—THOMAS MAKIN, Newton Farm, Castleford, Yorks., **Crackle.**

2nd, £15; 3rd, £10; 4th, £5; 5th, £3; 6th, £3 (divide). No. 1—S. W. WOODHALL, Mount Pleasant, Wellington, Shropshire, **Marina**; No. 11—**Brimstone**; No. 5—JOSEPH TAYLOR Moss Hall, Stretton, Warrington, **Praters**; No. 17—**Knut**; No. 12—E. ADCOCK, The Grange, Thurmaston, Leicester, **Pola**; No. 28—**Sandy**; No. 22—A. H. Ashcroft, Riding School, Aughton, Ormskirk, **Speculation**; No. 27—Grange Bros., Alvaston, Nantwich, **Desire.**

Class D.—*Mare or Gelding.*

1st, £20; 2nd, £15; 3rd, £10; 4th, £5; 5th, £3; 6th, £3 (divide). No. 6—A. H. ASHCROFT, Riding School, Aughton, Ormskirk, **Speculation**; No. 12—RICHARD PERRY, Home Farm, Sparkford, Yeovil, **Nettles**; No. 15—A. MASSARELLA & SONS, LTD., Belmont, Bentley, Doncaster, **Silver Mint**; No. 17—E. ADCOCK, The Grange, Thurmaston, Leicester, **Sandy**; No. 19—Thomas Makin, Newton Farm, Castleford, Yorks., **Crackle**; No. 23—Grange Bros., Alvaston, Nantwich, **Found**; No. 28—F. W. FOSTER, Friary Farm, Etwall, Derby, **Swank.**

Class E.—*Consolidation Class for Animals which have not won a Prize or Prizes amounting in the aggregate to £5 in Classes A to D.*

1st, £15. No. 53.—F. W. FOSTER, Friary Farm, Etwall, Derby, **Peter.**
2nd. £10. No. 52.—THOMAS MAKIN, Newton Farm, Castleford, Yorks., **Tony.**
3rd, £5 and 4th, £5 (divide). No. 48.—F. W. FOSTER, Friary Farm, Etwall, Derby, **Ayton.** No. 51.—JOSEPH TAYLOR, Moss Hall, Stretton, Warrington, **Praters.**
5th, £3. No. 40.—GRANGE BROS., Alvaston, Nantwich, **Desire.**
6th, £3. No. 50.—MRS. R. T. WHITEHEAD, Bryn Rhydderch, Abergavenny, **Sparkle.**

CATTLE.

Unless otherwise stated the Prizes for Cattle are as follows: First Prize, £15; Second Prize, £10; Third Prize, £5; Fourth Prize £4; Fifth Prize £3.

Shorthorns.

No. 606.—"Argentine" Silver Challenge Cup for the best Bull bred by Exhibitor; Shorthorn Society's Champion Prize of £20 for the best Bull and "Brothers Colling" Memorial Challenge Cup for the best Shorthorn to J. V. RANK'S **Bapton Aerial.**

No. 618.—R.N. for "Argentine" Silver Challenge Cup to J. V. RANK'S **Bapton Vanguard.**

No. 621.—R.N. for Shorthorn's Society's Champion Prize and R.N. for "Brothers Colling" Memorial Challenge Cup to DUNCAN M. STEWART'S **Coldoch Royal Flush.**

No. 646.—Shorthorn Society's Champion Prize of £20 for best Cow or Heifer to J. V. RANK'S **Bapton Vanity 2nd.**

No. 640.—R.N. for Shorthorn Society's Champion Prize to J. V. RANK'S **Bapton Crocus 24th.**

Shorthorn Society's Special Prizes for the best groups of three Shorthorns, bred by Exhibitor:—

1st, Nos. 606, 641, 646.—J. V. RANK'S **Bapton Aerial, Bapton Augusta 13th** and **Bapton Vanity 2nd.**

2nd, Nos. 637, 649, 654.—DUNCAN M. STEWART'S **Millhills Tipster, Crocus Queen 3rd** and **Millhills Luxury.**

Class 93.—*Shorthorn Bull, born in or before* 1935.

1st, No. 600.—G. M. HOPE, Basildon Home Farm, Pangbourne, Berks, **Bapton Realm** 274813.

2nd, No. 603.—J. V. RANK, Delaware, Edenbridge, Kent, **Calrossie Air Control** 268880.

3rd, No. 604.—W. H. YATES, Wychnor Bridges Farm, Burton-on-Trent, **Walshford Lancer** 280453.

Class 94.—*Shorthorn Bull, born on or between January 1st and March 31st,* 1936.

[No Entry.]

Class 95.—*Shorthorn Bull, born on or between April 1st and December 31st,* 1936.

1st, No. 606.—J. V. RANK, Delaware, Edenbridge, Kent, **Bapton Aerial 285604.**
2nd, No. 605.—MISS A. S. BROCKLEBANK, O.B.E., Wing Grange, Oakham, Rutland, **Wing Challenger 281442.**
3rd, No. 608.—G. N. WILSON, Aston Somerville, Broadway, Worcs., **Rickford Chorister** 287275.

Class 96.—*Shorthorn Bull, born on or between January 1st and March 31st,* 1937.*

1st, No. 621.—DUNCAN M. STEWART, Millhills, Crieff, **Coldoch Royal Flush.**
2nd, No. 618.—J. V. RANK, Delaware, Edenbridge, Kent, **Bapton Vanguard.**
3rd, No. 613.—WILLIAM GARNE, Aldsworth, Cheltenham, **Aldsworth Pope.**
4th, No. 609.—HIS MAJESTY THE KING, The Royal Farms, Windsor, **Windsor Solario.**
H.C. No. 611. C. Nos. 612, 615.

Class 97.—*Shorthorn Bull, born on or between April 1st and June 30th,* 1937

1st, No. 623.—MRS. W. R. CALVERT, Wetmore, Onibury, Shropshire, **Wetmore Coronation King.**
2nd, No. 627.—WILLIAM GARNE, Aldsworth, Cheltenham, **Aldsworth Bacchus.**
3rd, No. 631.—A. V. KEY, Coomb Farm, Llangynog, Llangain, Carm., **Rickford Rocket.**
R.N. No. 626.—EARL CAWDOR, The Home Farm, Stackpole, Pembroke, **Stackpole Laureate.**

Class 98.—*Shorthorn Bull, born on or between July 1st and December 31st,* 1937.*

1st, No. 637.—DUNCAN M. STEWART, Millhills, Crieff, **Millhills Tipster.**
2nd, No. 636.—J. V. RANK, Delaware, Edenbridge, Kent, **Bapton Royal Rover.**
3rd, No. 633.—EARL CAWDOR, The Home Farm, Stackpole, Pembroke, **Stackpole Rodney.**
R.N. No. 635.—H. & F. B. HIRSCH, Low Hall, Dacre, Harrogate, **Dacre Resolve.**

Class 99.—*Shorthorn Cow, in-milk, born in or before* 1934.

1st, No. 640.—J. V. RANK, Delaware, Edenbridge, Kent, **145439 Bapton Crocus 24th.**
2nd, No. 638.—G. M. HOPE, Basildon Home Farm, Pangbourne, Berks., **141993 Lady Rosemary 25th.**

Class 100.—*Shorthorn Heifer, in-milk, born in* 1935.

1st, No. 641.—J. V. RANK, Delaware, Edenbridge, Kent, 181476, **Bapton Augusta 13th.**
2nd, No. 642.—DUNCAN M. STEWART, Millhills, Creiff, **178963 Easter Fossoway Evelyn.**

Class 101.—*Shorthorn Heifer, born in* 1936.

1st, No. 646.—J. V. RANK, Delaware, Edenbridge, Kent, **191624 Bapton Vanity 2nd.**
2nd, No. 645.—J. V. RANK, Delaware, **191607 Bapton Actress 2nd.**
3rd, No. 644.—MISS A. S. BROCKLEBANK, O.B.E., Wing Grange, Oakham, Rutland, 185347 **Wing Crocus 7th.**
R.N. No. 643.—HIS MAJESTY THE KING, The Royal Farms, Windsor, 184329 **Windsor Crocus 5th.**

Class 102.—*Shorthorn Heifer, born on or between January 1st and March 31st,* 1937.

1st, No. 649.—DUNCAN M. STEWART, Millhills, Crieff, **Crocus Queen 3rd.**
2nd, No. 650.—DUNCAN M. STEWART, Millhills, **Millhills Paula.**
3rd, No. 647.—HIS MAJESTY THE KING, The Royal Farms, Windsor, **Windsor Golden Bud 3rd.**

Class 103.—*Shorthorn Heifer, born on or between April 1st and December 31st,* 1937.

1st, No. 653.—J. V. RANK, Delaware, Edenbridge, Kent, **Bapton Crocus 37th.**
2nd, No. 654.—DUNCAN M. STEWART, Millhills, Crieff, **Millhill Luxury.**
3rd, No. 652.—MRS. W. R. CALVERT, Wetmore, Onibury, Shropshire, **Wetmore Proud Augusta 2nd.**
R.N. No. 651.—MISS A. S. BROCKLEBANK, O.B.E., Wing Grange, Oakham, Rutland, **Wing Broadhooks 5th.**

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* 1st, 2nd and 3rd Prizes offered by the Shorthorn Society.

Herefords.

No. 666.—Perpetual Silver Challenge Trophy for the best Bull, Hereford Herd Book Society's Champion Prize of £10 10*s*. for the best Senior Bull and Argentine Challenge Trophy for the best Hereford to EDWARD WEBB & SONS (STOURBRIDGE), LTD.'S **Astwood Dandy.**

No. 671.—R.N. for Challenge Trophy for the best Bull, Hereford Herd Book Society's Champion Prize of £10 10*s*. for the best Junior Bull and R.N. for Argentine Challenge Trophy to R. S. DE Q. QUINCEY'S **Tarrington Punch.**

No. 665.—R.N. for Hereford Herd Book Society's Champion Prize for the best Senior Bull to R. S. DE Q. QUINCEY'S **Vern Nonsuch.**

No. 681.—R.N. for Hereford Herd Book Society's Champion Prize for the best Junior Bull to R. S. DE Q. QUINCEY'S **Vern Optimist.**

No. 713.—Hereford Herd Book Society's Champion Prize of £10 10*s*. for the best Cow or Heifer to W. E. LOCK'S **Prudence.**

No. 714.—R.N. for Champion Prize for the best Cow or Heifer to T. L. WALKER'S **Ankerdine Gwen.**

Class 104.—*Hereford Bull, born on or before August* 31*st*, 1935.

1st, No. 655.—THE APLEY ESTATES CO., Apley Home Farm, Norton, Shifnal, **Freetown Leander** 57236.
2nd, No. 656.—G. BEVAN & SONS, The Pant, Sarn, Newtown, Mont., **Paragon** 60570.
3rd, No. 658.—H. E. GOCHER, Netherhall, Roydon, Essex, **Netherhall Pandorus 24th** 58987.

Class 105.—*Hereford Bull, born on or between September* 1*st*, 1935 *and August* 31*st*, 1936.

1st, No. 666.—EDWARD WEBB & SONS (STOURBRIDGE), LTD., Astwood Farm, Stoke Works, Bromsgrove, **Aston Dandy** 59670.
2nd, No. 665.—R. S. DE Q. QUINCEY, The Vern, Bodenham, Hereford, **Vern Nonsuch** 60917.
3rd, No. 663.—MORGAN T. JONES, Sugwas Court Farm, Swainshill· Hereford, **Tree Town Highwayman** 60165.

Class 106.—*Hereford Bull, born on or between September* 1*st and November* 30*th*, 1936.*

1st, No. 671.—R. S. DE Q. QUINCEY, The Vern, Bodenham, Hereford, **Tarrington Punch** 62336.
2nd, No. 669.—LT.-COL. GEORGE P. POLLITT, Harnage Grange, Cressage, Shrewsbury, **Quisne Commander.**
3rd, No. 672.—R. S. DE Q. QUINCEY, The Vern, Bodenham, Hereford, **Vern Orion** 62420.
R.N. No. 668.—H. E. GOCHER, Netherhall, Roydon, Essex, **Netherhall Freetown Improver 4th** 61960.

Class 107.—*Hereford Bull, born on or between December* 1*st*, 1936 *and February* 28*th*, 1937.

1st, No. 681.—R. S. DE Q. QUINCEY, The Vern, Bodenham, Hereford, **Vern Optmist** 62417.
2nd, No. 679.—LT.-COL. GEORGE P. POLLITT, Harnage Grange, Cressage, Shrewsbury, **Quisne Charger.**
3rd, No. 675.—H. R. JENKINS, The Porch, Westhide, Hereford, **Weston Fancius** 62455.
4th, No. 673.—SIR EDWARD H. ROUSE BOUGHTON, BT., Downton Hall, Ludlow, **Downton Hall Caruso** 61488.
R.N. No. 674.—H. E. GOCHER, Netherhall, Roydon, Essex, **Netherhall Freetown Improver 8th.**

Class 108.—*Hereford Bull, born on or after March* 1*st*, 1937.

1st, No. 687.—T. L. D. EVERALL, Shrawardine Castle, Shropshire, **Shraden Kim** 62214.
2nd, No. 691.—CHARLES H. MORRIS, Weston Court, Pembridge, **Pygate Seal** 62074.
3rd, No. 689.—W. E. LOOK, Paunton Court, Bishops Frome, Worcester, **Paunton Nimrod.**
4th, No. 695.—R. S. DE Q. QUINCEY, The Vern, Bodenham, Hereford, **Vern Oswald.**
5th, No. 700.—JOHN WALKER, Knightwick Manor, Worcester, **Knightwick Peter Pan.**
R.N. No. 693.—F. J. NEWMAN, Wickton Court, Leominster, **Wickton Sultan** 62488.

Class 109.—*Hereford Cow or Heifer, in-milk, born on or before August* 31*st*, 1935.

1st, No. 703.—W. J. JENKINS & SONS, Marden Court, Hereford, **Charlton Peri 3rd** (Vol. 63 p. 529).

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* Prizes offered by the Hereford Herd Book Society.

Class 110.—*Hereford Heifer, born on or between September 1st,* 1935 *and August 31st,* 1936.

1st, No. 707.—F. J. NEWMAN, Wickton Court, Leominster, **Sultana 11th** (Vol. 67, p. 461).
2nd, No. 706.—THE APLEY ESTATES CO., Apley Farm, Norton, Shifnal, **Graceful** (Vol. 67, p. 181).
3rd, No. 710.—THOMAS L. WALKER, The Cedars, Broadwas-on-Teme, Worcester, **Ankerdine Pimple** (Vol. 67, p. 599).

Class 111.—*Hereford Heifer, born on or between September 1st and November 30th,* 1936.*

1st, No. 713.—W. E. LOCK, Paunton Court, Bishops Frome, Worcester, **Prudence** (Vol. 68, p. 439).
2nd, No. 714.—T. L. WALKER, The Cedars, Broadwas-on-Teme, Worcester, **Ankerdine Gwen** (Vol. 68, p. 631).
3rd, No. 712.—J. W. JONES & SONS, Sheephouse, Hay, Hereford, **Caramel** (Vol. 68, p. 327).
R.N. No. 711.—SIR EDWARD H. ROUSE BOUGHTON, BT., Downton Hall, Ludlow, **Downton Hall Saddie** (Vol. 68, p. 218).

Class 112.—*Hereford Heifer, born on or after December 1st,* 1936.

1st, No. 717.—MORGAN T. JONES, Sugwas Court Farm, Swainshill, Hereford, **Sugwas Daydream** (Vol. 68, p. 597).
2nd, No. 715.—THE APLEY ESTATES CO., Apley Home Farm, Norton, Shifnal, **Pearl** (Vol. 68, p. 197).
3rd, No. 719.—T. L. WALKER, The Cedars, Broadwas-on-Teme, Worcester, **Ankerdine Esther** (Vol. 68, p. 629).

Devons.

No. 723.—Devon Cattle Breeders' Society's Champion Prize of £10 10*s.* for the best Bull to HIS MAJESTY THE KING'S **Halsdon Defender.**
No. 725.—R.N. for Champion Prize to CECIL BRENT'S **Clampit Choice.**
No. 735.—Devon Cattle Breeders' Society's Champion Prize of £10 10*s.* for the best Cow or Heifer to ROBERT JOHN HARRIS' **Riddlecombe Cherry.**
No. 740.—R.N. for Champion Prize to P. M. WILLIAMS' **Werrington Miniature.**

Class 113.—*Devon Bull, born on or before* 1936.

1st, No. 720.—HIS MAJESTY THE KING, Home Farm, Stoke Climsland, Cornwall, **Whitefield Beacon** 17062.
2nd, No. 722.—FRED BEADLE, Stowey Farm, Timberscombe, Minehead, **Clampit Goldmine 3rd** 15212.

Class 114.—*Devon Bull, born in* 1937.

1st, No. 723.—HIS MAJESTY THE KING, Home Farm, Stoke Climsland, Cornwall, **Halsdon Defender** 17990.
2nd, No. 725.—CECIL BRENT, Clampit, Callington, Cornwall, **Clampit First Choice** 17899.
3rd, No. 724.—FRED BEADLE, Stowey Farm, Timberscombe, Minehead, **Stowey Snowstorm** 18149.
4th, No. 728.—W. J. KING, Manor Farm, Cothelestone, Taunton, **Cothelestone Ploughman** 17922.
R.N. No. 731.—P. M. WILLIAMS, Stowford, Chittlehampton, Devon, **Lufton Sovereign** 18058.
H.C. No. 727.

Class 115.—*Devon Cow or Heifer, in-milk, born in or before* 1935.

1st, No. 735.—ROBERT JOHN HARRIS, Riddlecombe Manor, Ashreigney, Chulmleigh, Devon, **Riddlecombe Cherry** 46665.
2nd, No. 734.—J. W. BUSSELL, Town Farm, Gittisham, Honiton, Devon, **Town Myrtle 43rd** 45764.
3rd, No. 733.—CECIL BRENT, Clampit, Callington, Cornwall, **Clampit Gay Lass 37th** 42985.
R.N. No. 736.—J. LAURISTON LEWIS, Coombe Cross, Templecombe, Somerset, **Temple Lucy** 46790.

Class 116.—*Devon Heifer, born in* 1936.

1st, No. 740.—P. M. WILLIAMS, Stowford, Chittlehampton, Devon, **Werrington Miniature** 48728.
2nd, No. 738.—J. W. BUSSELL, Town Farm, Gittisham, Honiton, Devon, **Town Myrtle 48th** 48873.
3rd, No. 737.—CECIL BRENT, Clampit, Callington, Cornwall, **Clampit Fancy 2nd** 48030.
R.N. No. 739.—W. J. KING, Manor Farm, Cothelestone, Taunton, **Cothelestone Fairmaid** 49136.

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* Prizes offered by the Hereford Herd Book Society.

Class 117.—*Devon Heifer, born in* 1937.

1st, No. 742.—His Majesty The King, Home Farm, Stoke Climsland, Cornwall, **Climsland Rosabel** 48783.
2nd, No. 741.—His Majesty The King, Stoke Climsland, **Climsland Princess** 48782.
3rd, No. 746.—Robert John Harris, Riddlecombe Manor, Ashreigney, Chulmleigh, Devon, **Riddlecombe Cherry 4th** 49058.
R.N. No. 743.—Fred Beadle, Stowey Farm, Timberscombe, Minehead, **Stowey Weekday 2nd** 48820.
H.C. No. 747.

Sussex.

No. 752.—Perpetual Challenge Trophy and Sussex Herd Book Society's Champion Silver Medal for the best Bull to Lord Leconfield's **Petworth Loyal 22nd.**
No. 749.—R.N. for Perpetual Challenge Trophy and Champion Silver Medal to Edward Hurtley's **Crowborough Warren Marksman 31st.**
No. 756.—Perpetual Challenge Cup for the best Sussex and Sussex Herd Book Society's Champion Silver Medal for the best Cow or Heifer to L. O. Johnson's **Kings Barn Dusky 7th.**
No. 752.—R.N. for Perpetual Challenge Cup to Lord Leconfield's **Petworth Loyal 22nd.**
No. 754.—R.N. for Champion Silver Medal to Col. J. R. Warren's **Hand Cross Knelle 4th.**

Class 118.—*Sussex Bull, born in* 1937.

1st, No. 752.—Lord Leconfield, Petworth House, Petworth, **Petworth Loyal 22nd** 8339.
2nd, No. 749.—Edward Hurtley, Crowborough Warrent, Sussex, **Crowborough Warren Marksman 31st** 8318.
3rd, No. 751.—L. O. Johnson, Peppers, Ashurst, Steyning, Sussex, **Kings Barn Rover 13th** 8328.

Class 119.—*Sussex Cow or Heifer, in-milk, born in or before* 1935.

1st, No. 754.—Col. J. R. Warren, O.B.E., M.C., The Hyde, Handcross, Haywards Heath, **Handcross Knelle 4th** 27758.
2nd, No. 753.—Col. J. R. Warren, O.B.E., M.C., The Hyde, **Handcross Cherry 7th** 27751.

Class 120.—*Sussex Heifer, born in* 1936.

1st, No. 756.—L. O. Johnson, Peppers, Ashurst, Steyning, Sussex, **Kings Barn Dusky 7th** 27958.
2nd, No. 755.—Edward Hurtley, Crowborough Warren, Sussex, **Crowborough Warren Crystal 6th** 27925.
3rd, No. 757.—Lord Leconfield, Petworth House, Petworth, **Petworth Gentle 3rd** 27966.
R.N. No. 758.—Col. J. R. Warren, O.B.E., M.C., The Hyde, Handcross, Haywards Heath, **Handcross Belle 1st** 28019.

Class 121.—*Sussex Heifer, born in* 1937.

1st, No. 761.—L. O. Johnson, Peppers, Ashurst, Steyning, Sussex, **Kings Barn Stonesdown 4th** 28201.
2nd, No. 763.—Col. J. R. Warren, O.B.E., M.C., The Hyde, Handcross, Haywards Heath, **Handcross Beauty 6th** 28254.
3rd, No. 760.—Edward Hurtley, Crowborough Warren, Sussex, **Crowborough Warren Daisy 8th** 28165.
R.N. No. 759.—Edward Hurtley, Crowborough Warren, **Crowborough Warren Crystal 8th** 28164.

Welsh.

£35 towards these Prizes offered by the Welsh Black Cattle Society.

No. 765.—Welsh Black Cattle Society's Champion Silver Medal for the best Bull to Lord Penrhyn's **Penrhyn Baron.**
No. 764.—R.N. for Champion Silver Medal to T. F. Dargie's **Cahn Penrhyn.**
No. 774.—Welsh Black Cattle Society's Champion Silver Medal for the best Cow or Heifer to Lord Penrhyn's **Calenig 15th of Penrhyn.**
No. 777.—R. N. for Champion Silver Medal to Mrs. E. H. Spottiswoode's **Gwern Holly.**
Nos. 765, 774, 775.—Welsh Black Cattle Society's Gold Medal for the best group of one Bull and two Cows or Heifers to Lord Penrhyn's **Penrhyn Baron, Calenig 15th of Penrhyn** and **Dorothy 10th of Penrhyn.**
No. 764, 773, 789.—R.N. for Gold Medal to T. F. Dargie's **Cahn Penrhyn, Towyn Sue, Ty Croes Betty.**

Class 122.—*Welsh Bull, born on or before November* 30*th,* 1935.

1st, No. 765.—Lord Penrhyn, Penrhyn Castle, Bangor, **Penrhyn Baron** 4967.
2nd, No. 764.—T. F. Dargie, Ty Mawr, Bryngwran, Holyhead, Anglesey, **Cahn Penrhyn** 4884.
3rd, No. 767.—Sir J. C. E. Shelley-Rolls, Bt., Avington, Winchester, **Hendre Gallant** 4757.
R.N. No. 766.—Richard E. Rees, Ynys Farm, Pennal, Machynlleth, **Ynys Caradog** 4858.

Class 123.—*Welsh Bull, born on or between December 1st,* 1935, *and November 30th,* 1936.

1st, No. 769.—MRS. E. H. SPOTTISWOODE, Rooksnest, Lambourn, Berks., **Gwern Launcelot** 5062.

Class 124.—*Welsh Bull, born on or between December 1st,* 1936 *and November 30th,* 1937.

1st, No. 770.—CAHN HILL IMPROVEMENT SCHEME, Pwllpeiran, Cwmystwyth, Aberystwyth, **Cahn Peiran 3rd.**
2nd, No. 771.—LORD PENRHYN, Penrhyn Castle, Bangor, **Penywern Ieuan.**
3rd, No. 772.—SIR J. C. E. SHELLEY-ROLLS, BT., Avington, Winchester, **Avington Knight.**

Class 125.—*Welsh Cow or Heifer, in-milk, born on or before November 30th,* 1935.

1st, No. 774.—LORD PENRHYN, Penrhyn Castle, Bangor, **Calenig 15th of Penrhyn** 11665.
2nd, No. 777.—MRS. E. H. SPOTTISWOODE, Rooksnest, Lambourn, Berks., **Gwern Holly** 12490.
3rd, No. 775.—LORD PENRHYN, Penrhyn Castle, Bangor, **Dorothy 10th of Penrhyn** 11658.
R.N. No. 773.—T. F. DARGIE, Ty Mawr, Bryngwran, Holyhead, Anglesey, **Towyn Sue** 13149.

Class 126.—*Welsh Heifer, born on or between December 1st,* 1935 *and November 30th,* 1936.

1st, No. 782.—RICHARD E. REES, Ynys Farm, Pennal, Machynlleth, **Ynys Bessie** 13486.
2nd, No. 787.—MRS. E. H. SPOTTISWOODE, Rooksnest, Lambourn, Berks., **Gwern Lyonesse** 13519.
3rd, No. 786.—THE HON. LADY SHELLEY-ROLLS, The Hendre, Monmouth, **Hendre Diamond** 13512.
R.N. No. 781.—LORD PENRHYN Penrhyn Castle, Bangor, **Telyn 23rd of Penrhyn** 13444.

Class 127.—*Welsh Heifer, born on or between December 1st,* 1936 *and November 30th,* 1937.

1st, No. 791.—RICHARD E. REES, Ynys Farm, Pennal, Machynlleth, **Ynys Doli.**
2nd, No. 789.—T. F. DARGIE, Ty Mawr, Bryngwran, Holyhead, Anglesey, **Ty Croes Betty**
3rd, No. 788.—CAHN HILL IMPROVEMENT SCHEME, Pwllpeiran, Cwmystwyth, Aberystwyth, **Cahn Myfunwy.**
R.N. No. 793.—MRS. E. H. SPOTTISWOODE, Rooksnest, Lambourn, Berks., **Gwern Megan.**

Class 128.—*Welsh Cow or Heifer, in-milk, any age, whose milk yield has been officially recorded and checked.*

1st, No. 777.—MRS. E. H. SPOTTISWOODE, Rooksnest, Lambourn, Berks., **Gwern Holly** 12490.
2nd, No. 794.—THE HON. LADY SHELLEY-ROLLS, The Hendre, Monmouth, **Grace** 11320

Park.

Class 129.—*Park Bull, born in or before* 1936.

1st, No. 795.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, Bletchley, **Woburn Pykent 9th** 525.
2nd, No. 796.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, **Woburn Mike 2nd** 651.

Class 130.—*Park Cow or Heifer, in-milk, born in or before* 1935.

1st, No. 797.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, Bletchley, 1766 **Woburn Buckingham 49th.**
2nd, No. 798.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, 2370 **Woburn Buckingham 60th.**
3rd, No. 799.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, 2602 **Woburn Pam.**
R.N. No. 802.—LORD DYNEVOR, Dynevor Castle, Llandilo, Carm., 2336 **Dynevor Splendid.**

Class 131.—*Park Heifer, born in* 1936.

1st, No. 804.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, Bletchley, 2600 **Woburn Primrose.**
2nd, No. 805.—LORD DYNEVOR, Dynevor Castle, Llandilo, Carm., 2552 **Dynevor Veracity**

Longhorns.

No. 808.—Longhorn Cattle Society's Silver Challenge Cup for the best Senior Longhorn to R. S. WALTERS' **Sutton Victor.**
No. 815.—R.N. for Silver Challenge Cup to W. E. SWINNERTON'S **Crickley Chestnut.**
No. 821.—Longhorn Cattle Society's Silver Challenge Cup for the best Junior Longhorn to R. S. WALTERS' **Sutton Vivienne.**
No. 810.—R.N. for Silver Challenge Cup to F. J. MAYO'S **Friar Pimpo.**

Class 132.—*Longhorn Bull, born in or before* 1936.

1st, No. 808.—R. S. WALTERS, Norfolk Lodge, Sutton Coldfield, **Sutton Victor** 948.
2nd, No. 806.—T. G. ARNOLD, Ashgrove, Warwick Road, Solihull, Warwickshire, **Finham Victor** 972.
3rd, No. 807.—R. S. WALTERS, Norfolk Lodge, Sutton Coldfield, **Sutton Doctor** 999.

Class 133.—*Longhorn Bull, born in* 1937.

1st, No. 810.—F. J. MAYO, Friar Waddon, Upwey, Weymouth, **Friar Pimpo** 995.
2nd, No. 811.—R. S. WALTERS, Norfolk Lodge, Sutton Coldfield, **Sutton Vivor** 1000.
3rd, No. 809.—R. R. HOLLICK, Stivichall Grange, Coventry, **Finham Victor 3rd** 994.

Class 134.—*Longhorn Cow or Heifer, in-milk, born in or before* 1935.

1st, No. 815.—W. E. SWINNERTON, Crickley Barrow House, Northleach, Glos., **Crickley Chestnut** (Vol. 17, p. 11).
2nd, No. 813.—F. J. MAYO, Friar Waddon, Upwey, Weymouth, **Friar Pet** (Vol. 17, p. 10).
3rd, No. 812.—T. G. ARNOLD, Ashgrove, Warwick Road, Solihull, Warwickshire, **Westwood Dewdrop** (Vol. 18, p. 4).
R.N. No. 817.—W. E. SWINNERTON, Crickley Barrow House, Northleach, Glos., **Crickley Garnet** (Vol. 19, p. 10).
H.C. No. 816.

Class 135.—*Longhorn Heifer, born in* 1936 *or* 1937.

1st, No. 821.—R. S. WALTERS, Norfolk Lodge, Sutton Coldfield, **Sutton Vivienne** (Vol. 20, p. 14).
2nd, No. 818.—R. R. HOLLICK, Stivichall Grange, Coventry, **Finham Daphne 5th** (Vol. 20, p. 7).
3rd, No. 819.—R. R. HOLLICK, Stivichall Grange, **Finham Princess 8th** (Vol. 20, p. 7).
R.N. No. 820.—W. E. SWINNERTON, Crickley Barrow House, Northleach, Glos., **Crickley Coral** (Vol. 20, p. 9).

Aberdeen-Angus.

No. 828.—Perpetual Challenge Trophy for the best Bull, English Aberdeen-Angus Cattle Association's Gold Medal for the best animal of opposite sex to winner of Champion Gold Medal, and R.N. for Aberdeen-Angus Cattle Society's Champion Gold Medal for the best Aberdeen-Angus to THE MARQUESS OF ZETLAND'S **Egloss of Sandyknowe.**
No. 822.—R.N. for Perpetual Challenge Trophy and R.N. for Gold Medal for best animal of opposite sex to winner of Champion Gold Medal to VISCOUNT ALLENDALE'S **Elmhore of Bywell.**
No. 859.—Aberdeen-Angus Cattle Society's Champion Gold Medal for the best Aberdeen-Angus and Silver Medal for the best animal bred in England and Wales to LADY ROBINSON'S **Magnolia of Kirklington.**
No. 855.—R.N. for Silver Medal to EDWARD A. WIGAN'S **Jubilee of Conholt.**
The "Mungoswalls" Silver Challenge Cup for the most points awarded in a combination of Aberdeen-Angus entries to LADY ROBINSON.
R.N. for the "Mungowalls" Silver Challenge Cup to THE MARQUESS OF ZETLAND.

Class 136.—*Aberdeen-Angus Bull, born on or before November 30th,* 1935.

1st, No. 828.—THE MARQUESS OF ZETLAND, G.C.S.I., G.C.I.E., Aske, Richmond, Yorks., **Egloss of Sandyknowe** 90709.
2nd, No. 822.—VISCOUNT ALLENDALE, Bywell, Stocksfield-on-Tyne, **Elmhore of Bywell** 87157.
3rd, No. 825.—SIR PRINCE PRINCE-SMITH, BT., Southburn, Driffield, **Prodigal of Southburn** 89118.

Class 137.—*Aberdeen-Angus Bull, born on or between December 1st,* 1935 *and November 30th,* 1936.

1st, No. 834.—LADY ROBINSON, Kirklington Hall, Newark, **Eagre of Kirklington** 94267.
2nd, No. 830.—THE EARL OF ELGIN, K.T., C.M.G., Broomhall, Dunfermline, **Epigram of Broomhall** 94629.
3rd, No. 833.—WILLIAM LEE, Hatch Gate Farm, Wargrave, Berks., **Enterprise of Hatchgate** 99067.

Class 138.—*Aberdeen-Angus Bull, born on or between December 1st,* 1936 *and November 30th,* 1937.

1st, No. 847.—WYNDHAM T. VINT, Terrys, Ormside, Appleby, Westmorland, **Etheric of Tillyrie 100059.**
2nd, No. 841.—CAPT. A. L. GOODSON, Kilham, Midrum, Northumberland, **Eulogist 2nd of Kilham 98427.**
3rd, No. 838.—The Eynsham Estate Co., Eynsham Hall, Witney, Oxon, **Echo of Eynsham 98153.**
4th, No. 845.—LADY ROBINSON, Kirklington Hall, Newark, **Endymion of Kirklington 100121.**
5th, No. 835.—CAPT. F. B. ATKINSON, Gallowhill, Morpeth, Northumberland, **Pericles of Gallowhill 97276.**

Class 139.—*Aberdeen-Angus Cow or Heifer, in-milk, born on or before November 30th,* 1935.

1st, No. 855.—EDWARD WIGAN, Conholt Park, Andover, Hants., **Jubilee of Conholt 110789.**
2nd, No. 852.—LADY ROBINSON, Kirklington Hall, Newark, **Everina 3rd of Ballintomb 107703.**
3rd, No. 851.—CAPT. A. L. GOODSON, Kilham, Mindrum, Northumberland, **Eulima 3rd of Kilham 96612.**
R.N. No. 850.—COL. J. F. N. BAXENDALE, Froxfield Green, Petersfield, Hants., **Era of Froxfield 101789.**

Class 140.—*Aberdeen-Angus Heifer, born on or between December 1st,* 1935 *and November 30th,* 1936.

1st, No. 859.—LADY ROBINSON, Kirklington Hall, Newark, **Magnolia of Kirklington 113525.**
2nd, No. 856.—THE EARL OF ELGIN, K.T., C.M.G., Broomhall, Dunfermline, **Black Sadie of Broomhall 111754.**
3rd, No. 860.—PERCY CHARLES STOVOLD, Rosemead, Milford, Godalming, **Mendosa of Addinston 112858.**
R.N. No. 861.—THE MARQUESS OF ZETLAND, G.C.S.I., G.C.I.E., Aske, Richmond, Yorks., **Aunita of Stonefold, 111317.**

Class 141.—*Aberdeen-Angus Heifer, born on or between December 1st,* 1936 *and November 30th,* 1937.

1st, No. 866.—THE EYNSHAM ESTATE CO., Eynsham Hall, Witney, Oxon, **Princess Maria of Sandyknowe 117431.**
2nd, No. 874.—LADY ROBINSON, Kirklington Hall, Newark, **Pride of Inverallan 18th 117167.**
3rd, No. 877.—THE MARQUESS OF ZETLAND, G.C.S.I., G.C.I.E., Aske, Richmond, Yorks., **Estrella of Aske 117769.**
4th, No. 862.—CAPT. F. B. ATKINSON, Gallowhill, Morpeth, Northumberland, **Black Bird of Gallowhill 114376.**
5th, No. 871.—VISCOUNT MONCK, Northington, Overton, Basingstoke, **Maria of Laverstoke 116431.**
R.N. No. 873.—LADY ROBINSON, Kirklington Hall, Newark, **Elderberry of Kirklington 116980.**

Belted Galloways.

No. 884.—The "Knockbrex" Silver Challenge Cup for the best Belted Galloway to the NALC Co.'s **Mark Advocate.**
No. 893.—R.N. for "Knockbrex" Silver Challenge Cup to the NALC Co.'s **Gartmore Winifred 8th.**

Class 142.—*Belted Galloway Bull, born on or before November 30th,* 1937.

1st, No. 884.—THE NALC COMPANY, LTD., Gartmore, Stirling, **Mark Advocate** 1085 B.
2nd, No. 878.—JAMES BROWN, Tellisford House, Clifton Down, Bristol, **Gartmore Marsden.**
3rd, No. 879.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, London, W.2, **Gartmore Noel 1147 B.**
R.N. No. 881.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, **Lullenden Hector** 1201 B.

Class 143.—*Belted Galloway Cow or Heifer, in-milk, born on or before November 30th,* 1935.

1st, No. 888.—THE NALC COMPANY, LTD., Gartmore, Stirling, **Gartmore Christian 3rd** 3220 B.
2nd, No. 889.—THE NALC COMPANY, LTD., Gartmore, **Gartmore Helen 2nd** 3328 B.
3rd, No. 886.—JAMES BROWN, Tellisford House, Clifton Down, Bristol, **Scatwell Duchess** 1924 B.
R.N. No. 887.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, London. W.2, **Gartmore Grace 3rd** 1032 B.

Class 144.—*Belted Galloway Heifer, born on or between December 1st,* 1935, *and November 30th,* 1936.

1st, No. 893.—THE NALC COMPANY, LTD., Gartmore, Stirling, **Gartmore Winifred 8th 3660 B.**
2nd, No. 892.—THE NALC COMPANY, LTD., Gartmore, **Gartmore Dandy 9th 3636 B.**
3rd, No. 890.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, London, W.2, **Gartmore Christian 6th 3632 B.**
R.N. No. 891.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, **Lullenden Bell 3706 B.**

Class 145.—*Belted Galloway Heifer, born on or between December 1st,* 1936, *and November 30th,* 1937.*

1st, No. 895.—THE NALC COMPANY, LTD., Gartmore, Stirling, **Gartmore Christian 7th 3740 B.**
2nd, No. 896.—THE NALC COMPANY, LTD., Gartmore, **Gartmore Helen 4th 3750 B.**
3rd, No. 894.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, London, W.2, **Lullenden Beauty 3rd 3852 B.**

Galloways.

Classes 146 to 149.—*Cancelled under Regulation* 10.

Highland.

Classes 150 to 152.—*Cancelled. No entries.*

Dairy Shorthorns.

No. 902.—Shorthorn Society's Champion Prize of £10 for the best Bull to MISS R. M. HARRISON'S **Townend Supreme.**
No. 903.—R.N. for Champion Prize to J. HEWSON & SONS' **Lyne Jubilee.**
No. 987.—Shorthorn Society's Champion Prize of £10 for the best Cow or Heifer to KING'S COLLEGE FARMS' **Holmescales Meadowsweet.**
No. 1017.—R.N. for Champion Prize to J. PIERPONT MORGAN'S **Aldenham Florentia 8th.**
Nos. 933, 1016, 1017.—"Brackenhurst" Silver Challenge Bowl for the best group of one Bull and two Cows or Heifers to J. PIERPONT MORGAN'S **Aldenham Festive Duke, Aldenham Barrington 11th** and **Aldenham Florentia 8th.**
Nos. 940, 1025, 1056.—R.N. for "Brackenhurst" Silver Challenge Bowl to the DUKE OF WESTMINSTER'S **Eaton Dodder, Eaton Winsonia 11th** and **Eaton Rosebud 11th.**
Nos. 968, 1012, 1034.—Perpetual Silver Challenge Cup for the best group of three Cows or Heifers by the same sire, to HOBBS & DAVIS' **Kelmcott Primula 217th, Kelmscott Betty 39th** and **Kelmscott Dulce 56th.**
Nos. 1025, 1054, 1056.—"Nottingham" Silver Challenge Bowl for the best group of three Cows or Heifers, in milk, to THE DUKE OF WESTMINSTER'S **Eaton Winsonia 11th, Eaton Red Rose 21st** and **Eaton Rosebud 11th.**

Class 153.—*Dairy Shorthorn Bull, born in or before* 1935.

1st, No. 902.—MISS R. M. HARRISON, O.B.E., Maer Hall, Newcastle, Staffs., **Townend Supreme 273852.**
2nd, No. 903.—J. HEWSON & SONS, Parton, Wigton, **Lyne Jubilee 278283.**
3rd, No. 897.—LT.-COL. R. W. BARCLAY, Bury Hill, Dorking, **Buryhill Imperial Bates 262317.**
4th, No. 906.—G. T. WEEKES, The Village Farm, Penhow, Newport, Mon., **Chalfield Lord Darlington 17th 275545.**
R.N. No. 899.—A. NORMAN CREYKE, Coton Grange, Whixall, Whitchurch, Shropshire, **Greencroft Marquis 257658.**
H.C. Nos. 904, 905. C. No. 901.

Class 154.—*Dairy Shorthorn Bull, born in* 1936.

1st, No. 909.—E. J. MANNERS, Netherseale, Burton-on-Trent, **Wemsbrook Marionette 2nd 282031.**
2nd, No. 915.—G. N. Wilson, Aston Somerville, Broadway, Worcs., **Whatcote Magician 4th 286457.**
3rd, No. 907.—CHIVERS & SONS, LTD., Histon, Cambridge, **Calcaria Wild Ambassador 286111.**

Class 155.—*Dairy Shorthorn Bull, born on or between January 1st and March 31st,* 1937.

1st, No. 922.—RALPH TUSTIAN, The Leys, Great Tew, Oxford, **Greattew Napoleon 3rd.**
2nd, No. 916.—LT.-COL. R. W. BARCLAY, Bury Hill, Dorking, **Buryhill Wildeyes Captain.**

* Offered by the Dun and Belted Galloway Cattle Breeders' Association.

3rd, No. 923.—RALPH TUSTIAN, The Leys, Great Tew, Oxford, **Greattew Trickster 23rd.**
4th, No. 920.—MISS R. M. HARRISON, O.B.E., Maer Hall, Newcastle, Staffs., **Oxton Emperor Oxford.**
R.N. No. 921.—D. M. LLOYD, Cwmeinon, Capel Dewi, Llandyssul, **Dewi Regal.**
C. No. 919.

Class 156.—*Dairy Shorthorn Bull, born on or between April 1st and June 30th*, 1937.

1st, No. 942.—JAMES WILD, Oak Cottage, Over Peover, Knutsford, **Eaton Dauntless.**
2nd, No. 940.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, **Eaton Dodder.**
3rd, No. 931.—E. MCGREGOR, Leicester Lane. Lillington, Leamington, **Wreay Wild Rover 3rd.**
4th, No. 933.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Aldenham Festive Duke.**
5th, No. 926.—MAJOR R. F. FULLER, Great Chalfield, Melksham, **Chalfield Mayor 5th.**
R.N. No. 937.—RALPH TUSTIAN, The Leys, Great Tew, Oxford, **Greattew Napoleon 5th.**
H.C. Nos. 929, 939. C. No. 927.

Class 157.—*Dairy Shorthorn Bull, born on or between July 1st and December 31st*, 1937.

1st, No. 948.—WILLIAM JACKSON, The Wreay, Wigton, **Wreay Wild Baronet 4th.**
2nd, No. 950.—E. J. MANNERS, Netherseale, Burton-on-Trent, **Netherseale Gallant Lord.**
3rd, No. 956.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, **Eaton Detective.**
4th, No. 953.—SIR MARTIN J. MELVIN, BT., Billesley Manor, Alcester, **Billesley Wild Mint.**
5th, No. 945.—MISS R. M. HARRISON, O.B.E., Maer Hall, Newcastle, Staffs., **Maerfield Supreme.**
R.N. No. 947.—J. HEWSON & SONS, Parton, Wigton, **Sizergh Bannock.**
H.C. No. 958.

Class 158.—*Dairy Shorthorn Cow, in-calf.*

1st, No. 968.—HOBBS & DAVIS, Kelmscott, Lechlade, 168495 **Kelmscott Primula 217th.**
2nd, No. 976.—S. A. N. WATNEY, Manor Farm, Catthorpe, Leics., 163697 **Acryse Red Rose.**
3rd, No. 977.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, 173632 **Eaton Red Rose 18th.**
4th, No. 981.—CAPT. ARNOLD S. WILLS, Thornby Hall, Northampton, 164156 **Thornby Barrington Duchess 9th.**
5th, No. 978.—JAMES WILD, Oak Cottage, Over Peover, Knutsford, 154946 **Careless 9th.**
R.N. No. 972—W. S. PUGH, Malpas Farm, Newport, Mon., 148917 **Gwersyllt Lily 3rd.**
H.C. No. 975. C. No. 966.

Class 159.—*Dairy Shorthorn Cow, in-milk, born in or before* 1931.*

1st, No. 987.—KING'S COLLEGE FARMS, Worlaby, Brigg, 142825 **Holmescales Meadowsweet.**
2nd, No. 982.—CAPT. T. ALLEN-STEVENS, Wicklesham Lodge, Faringdon, 135340 **Wicklesham Waterloo Molly 2nd.**
3rd, No. 991.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, 142161 **Highdenton Wild Queen.**
4th, No. 984.—JOHN CRONK, Skeynes Farm, Edenbridge, 136895 **Thurnham Rosebud 24th.**
R.N. No. 988.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, 141421 **Aldenham Barrington Lass 7th.**

Class 160.—*Dairy Shorthorn Cow, in-milk, born in* 1932.

1st, No. 998.—S. A. N. WATNEY, Manor Farm, Catthorpe, Leics., 154045 **Acryse Muriel Millicent.**
2nd, No. 994.—VISCOUNT HAMBLEDEN, Greenlands, Henley-on-Thames, 147462 **Anderson Wild Eyes 20th.**
3rd, No. 995.—MRS. K. HOLLAS, Parsonage Farm, Highworth, Wilts., 152428 **Ilford Cowslip 7th.**
R.N. No. 996.—SIR MARTIN J. MELVIN, BT., Billesley Manor, Alcester, 153795 **Greattew Waterloo Rose 3rd.**

Class 161.—*Dairy Shorthorn Cow, in-milk, born in* 1933.

1st, No. 1000.—CHIVERS & SONS, LTD., Histon, Cambridge, 159019 **Hambleton Flora Gwynne 2nd.**
2nd, No. 1008.—T. A. ROSE, Churchill Heath, Kingham, 163827 **Overnorton Rose Marie.**
3rd, No. 1007.—MAJOR G. MILLER MUNDY, Red Rice, Andover, 155692 **Sparr Gentle 2nd.**
4th, No. 1006.—KING'S COLLEGE FARMS, Worlaby, Brigg, 156513 **St. Clere Daffodil 20th.**
R.N. No. 1003.—SIR WILLIAM HICKING, BT., Brackenhurst Hall, Southwell, Notts., 158676 **Brackenhurst Joan.**

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* 1st, 2nd and 3rd Prizes offered by the Shorthorn Society.

Class 162.—*Dairy Shorthorn Cow or Heifer, in-milk, born in or after* 1934.

1st, No. 1017.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, 170557 **Aldenham Florentia 8th.**
2nd, No. 1015.—PERCY J. MASON, Porch Farm, Godmanchester, Hunts., 170240 **Porch Agnes 2nd.**
3rd, No. 1022.—Tudge & Maybery, Whittingslow, Marsh Brook, Shropshire, 173206 **Whittingslow Freckles.**
4th, No. 1025.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, 173646 **Eaton Winsonia 11th.**
5th, No. 1012.—Hobbs & Davis, Kelmscott, Lechlade, 168467 **Kelmscott Betty 39th.**
R.N. No. 1018.—MAJOR G. MILLER MUNDY, Red Rice, Andover, 70649 **Redrice Darling 10th.**
H.C. No. 1014. **C.** No. 1016.

Class 163.—*Dairy Shorthorn Heifer, in-milk (to first calving), born in or after* 1935.*

1st, No. 1029.—SIR WILLIAM HICKING, BT., Brackenhurst Hall, Southwell, Notts. 178277 **Brackenhurst Cerise Royal.**
2nd, No. 1056.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, 183649 **Eaton Rosebud 11th.**
3rd, No. 1041.—A. THOMAS LOYD, Lockinge House, Wantage, 180991 **Wokefield Darlington Duchess 10th.**
4th, No. 1048.—T. A. ROSE, Churchill Heath, Kingham, 182055 **Churchill Edna 33rd.**
5th, No. 1061.—CAPT. ARNOLD S. WILLS, Thornby Hall, Northampton, 184019 **Thornby Darling Duchess 9th.**
R.N. No. 1054.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, 183648 **Eaton Red Rose 21st.**
H.C. No. 1035. **C.** No. 1028.

Lincolnshire Red Shorthorns.

No. 1062.—Lincolnshire Red Shorthorn Challenge Cup for the best Bull to MAJOR E. C. BOWES' **Anwick Instructor.**
No. 1064.—R.N. for Challenge Cup to H. GORE BROWNE'S **Coleby Herald.**
No. 1074.—Lincolnshire Red Shorthorn Challenge Cup for the best Cow or Heifer to C. L. BEMBRIDGE'S **Anwick No. 234.**
No. 1100.—R. N. for Challenge Cup to C. L. BEMBRIDGE'S **Anwick Hannah.**

Class 164.—*Lincolnshire Red Shorthorn Bull, born in or before* 1936.

1st, No. 1062.—MAJOR E. C. BOWES, Chippinghurst Manor, Cuddesdon, Oxon, **Anwick Instructor** 26361.
2nd, No. 1064.—H. GORE BROWNE, Broombriggs, Woodhouse Eaves, Loughborough, **Coleby Herald** 29001.
3rd, No. 1066.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., **Walcott Envoy 6th** 28243.

Class 165.—*Lincolnshire Red Shorthorn Bull, born in* 1937.

1st, No. 1068.—MAJOR E. C. BOWES, Chippinghurst Manor, Cuddesdon, Oxon, **Chippinghurst Dominion.**
2nd, No. 1067.—C. L. BEMBRIDGE, Walcott, Lincoln, **Anwick Nelson.**
3rd, No. 1069.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., **Kirton Graduate.**
R.N. No. 1070.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Histon Dairy King 39th.**

Class 166.—*Lincolnshire Red Shorthorn Cow or Heifer, in-milk, born in or before* 1935.†

1st, No. 1074.—C. L. BEMBRIDGE, Walcott, Lincoln, **Anwick No. 234** (Vol. 40, p. 205).
2nd, No. 1079.—E. S. TANSLEY, Willoughby Manor, Alford, Lincs., **Seaholm Dolly 2nd** (Vol. 40, p. 352).
3rd, No. 1075.—H. GORE BROWNE, Broombriggs, Woodhouse Eaves, Loughborough, **Broombriggs Biddy** (Vol. 41, p. 219).
4th, No. 1076.—J. A. MARSDEN POPPLE, Daneshill, Stevenage, Herts., **Castlethorpe Alice** (Vol. 38, p. 289).
R.N. No. 1081.—RUSSELL WOOD, Bendish, Hitchin, **Bendish Woodland Rose 9th** (Vol. 37, p. 341).
H.C. No. 1080.

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* 1st, 2nd and 3rd Prizes offered by the Shorthorn Society.
† 1st, 2nd and 3rd Prizes offered by the Lincolnshire Red Shorthorn Association.

Class 167.—*Lincolnshire Red Shorthorn Cow, in-milk, born in or before* 1933, *showing the best milking properties.*

1st, No. 1082.—CHIVERS & SONS, LTD., Histon, Cambridge, **Bendish Charm 20th** (Vol. 39, p. 311).
2nd, No. 1085.—RUSSELL WOOD, Bendish, Hitchin, **Bendish Nancy 31st** (Vol. 40, p. 363).
3rd, No. 1083.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Ashleaf 13th** (Vol. 39, p. 194).
R.N. No. 1084.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Honour 2nd** (Vol. 40, p. 337).

Class 168.—*Lincolnshire Red Shorthorn Cow or Heifer, in-milk, born in or after* 1934, *showing the best milking properties.**

1st, No. 1087.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Fanny 13th** (Vol 41, p. 230).
2nd, No. 1086.—CHIVERS & SONS, LTD., Histon, **Histon Acacia 6th** (Vol. 41, p. 228).
3rd, No. 1088.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Betty 5th** (Vol. 41, p. 339).
R.N. No. 1090.—RUSSELL WOOD, Bendish, Hitchin, **Bendish Cherry 54th** (Vol. 41, p. 386).

Class 169.—*Lincolnshire Red Shorthorn Heifer, born in* 1936.

1st, No. 1095.—J. A. MARSDEN POPPLE, Daneshill, Stevenage, Herts., **Castlethorpe Dora** L. 1976.
2nd, 1093.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., **Kirton Gift** L. 1510.

Class 170.—*Lincolnshire Red Shorthorn Heifer, born in* 1937.

1st, No. 1100.—C. L. BEMBRIDGE, Walcott, Lincoln, **Anwick Hannah.**
2nd, No. 1098.—S. CECIL ARMITAGE, Lenton Fields, Nottingham, **Lenton Violet 9th.**
3rd, No. 1104.—H. GORE BROWNE, Broombriggs, Woodhouse Eaves, Loughborough, **Broombriggs Eileen.**
4th, No. 1101.—C. L. BEMBRIDGE, Walcott, Lincoln, **Anwick Rachel.**
R.N. No. 1097.—HIS MAJESTY THE KING, Sandringham, Norfolk, **Wolferton Ruby 21st.**
H.C. No. 1099.

South Devons.

No. 1108.—South Devon Herd Book Society's Silver Challenge Cup for the best Bull to J. P. CUNDY & SON'S **Pamflete Buck.**
No. 1114.—R.N. for Silver Challenge Cup to R. W. CHAFFE'S **Worswell Prince.**
No. 1121.—South Devon Herd Book Society's Silver Challenge Cup for the best Cow to J. HENDY'S **Alston Lassie 5th.**
No. 1119.—R.N. for Silver Challenge Cup to JOHN T. DENNIS' **Coleridge Flirt.**

Class 171.—*South Devon Bull, born in or before* 1936.

1st, No. 1108.—J. P. CUNDY & SONS, Estover Farms, Plympton, Devon, **Pamflete Buck** 13345.
2nd, No. 1110.—JOHN A. IRISH, Edmeston, Modbury, Devon, **Trehele King 2nd** 13603.
3rd, No. 1111.—W. C. C. PEDRICK, Charford, Avonwick, South Brent, **Worswell Kartiphillos** 13409.
R.N. No. 1113.—GEORGE WILLS, Home Farm, Haccombe, Newton Abbot, **East Farm No. 41** 14070.
H.C. No. 1112.

Class 172.—*South Devon Bull, born in* 1937.

1st, No. 1114.—R. W. CHAFFE, Worswell Barton, Revelstoke, Devon, **Worswell Prince** 14434.
2nd, No. 1117.—JOHN A. IRISH, Edmeston, Modbury, Devon, **Edmeston Marquis** 14278.
3rd, No. 1115.—JOHN T. DENNIS, Winsor, Yealmpton, Devon, **Winsor Perfection 3rd** 14425.
R.N. No. 1116.—J. HENDY, Alston, Holbeton, Devon, **Holbeton Pilot** 14320.

Class 173.—*South Devon Cow or Heifer, in-milk, born in or before* 1935.

1st, No. 1121.—J. HENDY, Alston, Holbeton, Devon, **Alston Lassie 5th,** 36333.
2nd, No. 1119.—JOHN T. DENNIS, Winsor, Yealmpton, Devon, **Coleridge Flirt** 37326.
3rd, No. 1122.—J. HENDY, Alston, Holbeton, Devon, **Alston Lassie 8th** 37658.
R.N. No. 1120.—JOHN T. DENNIS, Winsor, Yealmpton, Devon, **Winsor Snowdrop 5th,** 36895.
H.C. Nos. 1118, 1124.

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* Offered by the Lincolnshire Red Shorthorn Association.

Class 174.—*South Devon Heifer, born in* 1936 *or* 1937.

1st, No. 1128.—MAJOR SIR CHARLES E. B. HANSON, BT., Fowey Hall, Fowey, Cornwall, **Lawhyre Molly 42nd** 39161.
2nd, No. 1125.—E. V. BUNDAY, Rydon, Ogwell, Newton Abbot, **C. P. Allenhayes Janis 1st** part III Class A 174.
3rd, No. 1127.—MAJOR SIR CHARLES E. B. HANSON, BT., Fowey Hall, Fowey, Cornwall, **Lawhyre Beauty 20th** 39633.
R.N. No. 1126.—R. W. CHAFFE, Worswell Barton, Revelstoke, Devon, **Worswell Cornflower 10th** 39023.
H.C. No. 1129.

Red Polls.

No. 1134.—Red Poll Cattle Society's Champion Prize of £5 for the best Bull to CAPT. C. S. SCHREIBER'S **Brightwell Prospect.**
No. 1131.—R.N. for Champion Prize to SIR GUY HAMBLING'S **Yoxford Stormer.**
No. 1171.—The Red Poll Cattle Society's Champion Prize of £5 for best Cow or Heifer to LT.-COL. SIR MERRIK R. BURRELL'S **Knepp Minerva 23rd.**
No. 1204.—R.N. for Champion Prize to J. G. GRAY'S **Abbeycombe Rosina 2nd.**
Nos. 1159, 1171, 1185.—" Henham " Silver Challenge Cup for the best group of one Bull and two Cows or Heifers bred by Exhibitor to LT.-COL. SIR MERRIK R. BURRELL'S **Knepp Patrick, Knepp Minerva 23rd** and **Knepp Minerva 25th.**
Nos. 1165, 1178, 1198.—R.N. for Henham Silver Challenge Cup to LADY LODER'S **Leonardslee Bright Boy, Leonardslee Blackberry** and **Leonardslee Wild Rose 3rd.**

Class 175.—*Red Poll Bull, born in or before* 1935.

1st, No. 1134.—CAPT. C. S. SCHREIBER, Marlesford Hall, Woodbridge, Suffolk, **Brightwell Prospect** 17305.
2nd, No. 1131.—SIR GUY HAMBLING, BT., Rookery Park, Yoxford, Suffolk, **Yoxford Stormer** 17596.
3rd, No. 1130.—J. G. GRAY, Coombe Abbey, Coventry, **Abbeycombe Kentime** 17257.
H.C. No. 1132.

Class 176.—*Red Poll Bull, born in* 1936.

1st, No. 1139.—J. G. GRAY, Coombe Abbey, Coventry, **Abbeycombe Lybrosa** 17946.
2nd, No. 1143.—H. D. LONGE, Abbot's Hall, Stowmarket, **Combs Yellow Beacon** 18050.
3rd, No. 1145.—STUART PAUL, Kirton Lodge, Ipswich, **Parham Murphy** 18241.
4th, No. 1141.—SIR GUY HAMBLING, BT., Rookery Park, Yoxford, Suffolk, **Yoxford Stormer 2nd** 17942.
H.C. Nos. 1136, 1140.

Class 177.—*Red Poll Bull, born on or between January* 1*st and May* 31*st,* 1937.

1st, No. 1150.—LORD GLANELY, Exning House, Newmarket, **Exning Randal** 18076.
2nd, No. 1151.—J. G. GRAY, Coombe Abbey, Coventry, **Abbeycombe Favian 2nd** 17943.
3rd, No. 1152.—J. G. GRAY, Coombe Abbey, **Abbeycombe Mikado** 17951.
4th, No. 1156.—TREVOR PRICE, The Old House, Calmsden, Cirencester, **Ciceter Loyal King 2nd** 18034.
5th, No. 1153.—MRS. M. L. GRIFFITHS, Little Hallingbury Park, Essex, **Hallingbury Red Rover.**
H.C. No. 1148. C. No. 1155.

Class 178.—*Red Poll Bull, born on or between June* 1*st, and December* 31*st,* 1937.*

1st, No. 1165.—LADY LODER, Leonardslee, Horsham, **Leonardslee Bright Boy** 18149.
2nd, No. 1164.—LT.-COL. C. HEYWORTH-SAVAGE, Bradwell Grove, Burford, Oxford, **Leonardslee Coronation** 18150.
3rd, No. 1162.—J. G. GRAY, Coombe Abbey, Coventry, **Abbeycombe MacKnight** 17948.
4th, No. 1161.—LADY DENMAN, Balcombe Place, Balcombe, Sussex, **Balcombe Chimpanzee** 17958.
H.C. No. 1159. C. No. 1167.

Class 179.—*Red Poll Cow, in-milk, born in or before* 1932.

1st, No. 1171.—LT.-COL. SIR MERRIK R. BURRELL, BT., C.B.E., Knepp Castle Estate Office, Horsham, 49665 **Knepp Minerva 23rd.**
2nd, No. 1174.—J. G. GRAY, Coombe Abbey, Coventry, 46505 **Abbeycombe Royal Rosie 2nd.**
3rd, No. 1178.—LADY LODER, Leonardslee, Horsham, 49726 **Leonardslee Blackberry.**

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* 1st, 2nd and 3rd Prizes offered by the Red Poll Cattle Society.

4th, No. 1176.—MRS. M. L. GRIFFITH, Little Hallingbury Park, Essex, 47277 **Hallingbury Ruby 2nd.**
R.N. No. 1170.—MISS M. H. BOUVERIE, O.B.E., Delapre Abbey, Northampton, 49869 **Melton Mangrove.**
H.C. No. 1180.

Class 180.—*Red Poll Cow or Heifer, in-milk, born in* 1933 *or* 1934.*

1st, No. 1198.—LADY LODER, Leonardslee, Horsham, 51866 **Leonardslee Wild Rose 3rd.**
2nd, No. 1185.—LT.-COL. SIR MERRIK R. BURRELL, BT., C.B.E., Knepp Castle Estate Office, Horsham, 51809 **Knepp Minerva 25th.**
3rd, No. 1195.—LT.-COL. C. HEYWORTH-SAVAGE, Bradwell Grove, Burford, Oxford, 50824 **Bradwell Clarissa.**
4th, No. 1181.—HIS MAJESTY THE KING, Sandringham, Norfolk, 54446 **Royal Delusion.**
5th, No. 1192.—SIR GUY HAMBLING, BT., Rookery Park, Yoxford, Suffolk, 54934 **Yoxford Mavis 5th.**
R.N. No. 1186.—LORD CRANWORTH, Grundisburgh Hall, Suffolk, 51475 **Grundisburgh Portia.**
H.C. No. 1187.

Class 181.—*Red Poll Heifer, in-milk (to first calving). born in* 1935.*

1st, No. 1204.—J. G. GRAY, Coombe Abbey, Coventry, 54961 **Abbeycombe Rosina 2nd.**
2nd, No. 1202.—S. W. CROSS, Dairy Farm, Ixworth, Bury St. Edmunds, 56927 **Tittleshall Maroon.**
3rd, No. 1201.—LT.-COL. SIR MERRIK R. BURRELL, BT., C.B.E., Knepp Castle Estate Office, Horsham, 56169 **Knepp Minerva 28th.**
R.N. No. 1208.—CAPT. C. S. SCHREIBER, Marlesford Hall, Woodbridge, Suffolk, 56329 **Marlesford Charm.**
H.C. No. 1205. **C.** No. 1200.

Class 182.—*Red Poll Heifer, born in* 1936.

1st, No. 1214.—SIR GUY HAMBLING, BT., Rookery Park, Yoxford, Suffolk, 59309 **Yoxford Mavis 7th.**
2nd, No. 1213.—J. G. GRAY, Coombe Abbey, Coventry, 57171 **Arwarton Mimosa 4th.**
3rd, No. 1209.—HIS MAJESTY THE KING, Sandringham, Norfolk, 58854 **Royal Mab.**
R.N. No. 1211.—THE TRUSTEES OF THE CONDOVER ESTATE, Condover, Shropshire, 57733 **Condover Fairy 3rd.**

Class 183.—*Red Poll Heifer, born in* 1937.

1st, No. 1223.—STUART PAUL, Kirton Lodge, Ipswich, 60393 **Kirton Marina.**
2nd, No. 1218.—THE TRUSTEES OF THE CONDOVER ESTATE, Condover, Shropshire, 59865 **Condover Wendy.**
3rd, No. 1219.—J. G. GRAY, Coombe Abbey, Coventry, 59342 **Abbeycombe Rosina 3rd.**
4th, No. 1221.—LT.-COL. C. HEYWORTH-SAVAGE, Bradwell Grove, Burford, Oxford, 59566 **Bradwell Drusilla.**
R.N. No. 1222.—STUART PAUL, Kirton Lodge, Ipswich, 60378 **Kirton Dignity.**
H.C. No. 1224. **C.** No. 1216.

Blue Albions.

£75 towards these Prizes offered by the Blue Albion Cattle Society.

No. 1225.—Blue Albion Cattle Society's Silver Challenge Cup for the best Bull to THE EXORS. OF JOHN BASSETT'S **Asherblue Dairyman.**
No. 1229.—R.N. for Challenge Cup to THE EXORS. OF JOHN BASSETT'S **Asherblue Major.**
No. 1231.—Blue Albion Cattle Society's Silver Challenge Cup for the best Cow or Heifer to T. H. CALDERBANK'S **Stow Doreen.**
No. 1240.—R.N. for Challenge Cup to C. H. GOODWIN'S **Crossfields Fluster.**

Class 184.—*Blue Albion Bull, born in or before* 1936.

1st, No. 1225.—THE EXORS. OF JOHN BASSETT, Hill Top Farm, Ashover, Derbyshire, **Asherblue Dairyman 21051.**
2nd, No. 1226.—W. E. GLOVER, The Shrubberies, Snarestone, Burton-on-Trent, **Snarestone Baron 2nd 2145.**
3rd, No. 1227.—C. H. GOODWIN, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Ridgewardine Diadem.**
R.N. No. 1228.—CHARLES HENRY WEBSTER, Ivonbrook Farm, Grange Mill, Derby, **Ivonbrook Royal.**

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* 1st, 2nd and 3rd Prizes offered by the Red Poll Cattle Society.

Class 185.—*Blue Albion Bull, born in* 1937.

1st, No. 1229.—THE EXORS. OF JOHN BASSETT, Hill Top Farm, Ashover, Derbyshire, **Asherblue, Major** 2073.
2nd, No. 1230.—W. E. GLOVER, The Shrubberies, Snarestone, Burton-on-Trent, **Snarestone Prince** 2151.

Class 186.—*Blue Albion Cow or Heifer, in-milk, born in or before* 1935

1st, No. 1231.—T. H. CALDERBANK, The Hall, Stow Maries, Chelmsford, **Stow Doreen** 13270.
2nd, No. 1235.—C. H. GOODWIN, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Marlene of Crossfields.**
3rd, No. 1236.—CHARLES HENRY WEBSTER, Ivonbrook Farm, Grange Mill, Derby, **Ivonbrook Poppy** 13112.

Class 187.—*Blue Albion Heifer, born in* 1936.

1st, No. 1240.—C. H. GOODWIN, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Crossfields Fluster** 13404.
2nd, No. 1242.—CHARLES HENRY WEBSTER, Ivonbrook Farm, Grange Mill, Derby, **Ivonbrook Dainty 2nd** 13456.
3rd, No. 1238.—W. E. GLOVER, The Shrubberies, Snarestone, Burton-on-Trent, **May Queen of Snarestone** 521. S.R.
R.N. No. 1237.—THE EXORS. OF JOHN BASSETT, Hill Top Farm, Ashover, Derbyshire, **Asherblue Pop.**

Class 188.—*Blue Albion Heifer, born in* 1937.

1st, No. 1246.—CHARLES HENRY WEBSTER, Ivonbrook Farm, Grange Mill, Derby, **Ivonbrook Jessie 2nd** 13468.
2nd, No. 1243.—THE EXORS. OF JOHN BASSETT, Hill Top Farm, Ashover, Derbyshire, **Asherblue Popsy** 13332.
3rd, No. 1245.—C. H. GOODWIN, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Crossfields Geranium** 13416.

British Friesians.

ABBREVIATION.—P.I., Pure imported blood.

No. 1254.—"Mayford" Silver Challenge Trophy, the British Friesian Cattle Society's Champion Prize of £10 for the best Bull and the "Douneside" Silver Challenge Cup for the best Bull bred by Exhibitor to MRS. P. TORY'S **Crawford Bestain.**
No. 1255.—R.N. for "Mayford" Silver Challenge Trophy and Champion Prize of £10 to ALBERT WEIGHTMAN'S **Herrington (imp. 1936) Leo.**
No. 1262.—R.N. for "Douneside" Challenge Cup to MRS. GRAHAM REES-MOGG'S **Cliffordchambers Max.**
No. 1293.—British Friesian Cattle Society's Champion Prize of £10 for the best Cow or Heifer to JAMES HOLLINGSWORTH'S **Gowrie Marigold.**
No. 1317.—R.N. for Champion Prize to TRUSTEES OF SIR ALASDAIR W. MACROBERT'S **Douneside (imp. 1936) Aaltje.**
Nos. 1330, 1340, 1352.—British Friesian Cattle Society's Gold Medal for the best group of three Cows or Heifers to G. B. RADCLIFFE'S **Tarvin Mairschaap Irene 2nd, Tarvin Sunflower 5th** and **Tarvin Arnold Irene.**
Nos. 1333, 1341, 1353.—R.N. for Gold Medal to ALBERT WEIGHTMAN'S **Herrington Mayflower, Herrington Maureen 2nd** and **Herrington Rosalind.**
Nos. 1330, 1340, 1352.—Perpetual Bronze Challenge Trophy for the best group of three British Friesians, bred by Exhibitor, to G. B. RADCLIFFE'S **Tarvin Mairschaap Irene 2nd, Tarvin Sunflower 5th** and **Tarvin Arnold Irene.**
Nos. 1277, 1341, 1353.—R.N. for Perpetual Bronze Challenge Trophy to ALBERT WEIGHTMAN'S **Herrington Romance, Herrington Maureen 2nd** and **Herrington Rosalind.**

Class 189.—*British Friesian Bull, born in or before* 1935.

1st, £20. No. 1254.—MRS. P. TORY, Shapwick, Blandford, Dorset, **Crawford Bestain** 43667.
2nd, £15. No. 1255.—ALBERT WEIGHTMAN, Middle Herrington Farm, Sunderland, **Herrington (imp. 1936) Leo** 46237.
3rd, £10. No. 1247.—ARTHUR ALLEN, The Manor, Chesterblade, Som., **Sukar** (imp. 1936) **Auklod** 47077.
4th, £4. No. 1251.—JOHN LEWIS, Foxhole, St. Clears, Carmarthen, **Newhall Dutch Boy** 46631.

Class 190.—*British Friesian Bull, born in 1936.*

1st, No. 1262.—Mrs. Graham Rees-Mogg, Clifford Manor, Stratford-on-Avon, **Cliffordchambers Max** 47655 P.I.
2nd, No. 1260.—T. G. Fairhead, Little Chesterford, Saffron Walden, **Terling Carlino** 48523.
3rd, No. 1259.—W. Curtis & Son, Berwick Manor, Rainham, Essex, **Terling Viking 2nd** 48539.

Class 191.—*British Friesian Bull, born on or between January 1st and June 30th, 1937.*

1st, No. 1277.—Albert Weightman, Middle Herrington Farm, Sunderland, **Herrington Romance** 49723 P.I.
2nd, No. 1267.—Ernest B. Hall, Hales Hall, Market Drayton, **Hales Zwartguard** 49623.
3rd, No. 1268.—Ernest B. Hall, Hales Hall, **Hales Zwart Theme** 49631 P.I.
4th, No. 1272.—The Trustees of Sir Alasdair W. MacRobert, Bt., Douneside, Tarland, Aboyne, Aberdeenshire, **Douneside Lodbert 10th** 49319.
5th, No. 1264.—F. Chandler, Someries Farm, Luton, **Someries Pel** 50531 P.I.
R.N. No. 1273.—The Trustees of Sir Alasdair W. MacRobert, Bt., Douneside, Tarland, Aboyne, Aberdeenshire, **Douneside Lodbert 11th** 49321.

Class 192.—*British Friesian Bull, born on or between July 1st and December 31st, 1937.*

1st, No. 1285.—W. G. Player, Whatton Manor, Whatton-in-the-Vale, Notts., **Ednaston Zwarthak 3rd.**
2nd, No. 1283.—W. G. Player, Whatton Manor, **Ednaston Zwarthak 2nd.**
3rd, No. 1291.—Albert Weightman, Middle Herrington Farm, Sunderland, **Herrington Repeal.**
4th, No. 1289.—Mrs. Graham Rees-Mogg, Clifford Manor, Stratford-on-Avon, **Cliffordchambers Neville.**
5th, No. 1280.—Ernest B. Hall, Hales Hall, Market Drayton, **Hales Zwartlight.**
R.N. No. 1290.—Francis N. Terry, Chebbard, Dorchester, Dorset, **Redling Lex.**

Class 193.—*British Friesian Cow, in-calf.**

1st, No. 1293.—James Hollingworth, Manor Dairy Farm, Coddington, Newark, **Gowrie Marigold** 156938.
2nd, No. 1292.—Alfred J. Creed, Goldicote House, Stratford-on-Avon, **Royal Akke 19th** 171864.
3rd, No. 1299.—Albert Weightman, Middle Herrington Farm, Sunderland, **Golf Bloommijn 7th** 127284.
4th, No. 1297.—G. B. Radcliffe, Pool Bank, Tarvin, Cheshire, **Tarvin** (imp. 1936) **Mathilda** 206316.
R.N. No. 1300.—Albert Weightman, Middle Herrington Farm, Sunderland, **Herrington Love-in-a-Mist** 157550.
H.C. No. 1294.

Class 194.—*British Friesian Cow, in-milk, born in or before 1932, having yielded a minimum of 8,000 lb. of milk during a lactation period of 315 days.**

1st, **£20.** No. 1303.—W. Curtis & Son, Berwick Manor, Rainham, Essex, **Overton Ruth** 170980.
2nd, **£15.** No. 1310.—Mrs. P. Tory, Shapwick, Blandford, Dorset, **Crawford Nels Hope 2nd** 135528.
3rd, **£15.** No. 1309.—Francis N. Terry, Chebbard, Dorchester, **Shapwick Snap** 151064.
4th, **£4.** No. 1308.—Francis N. Terry, Chebbard, **Chebbard Heather** 134824.
R.N. No. 1302.—W. Curtis & Son, Berwick Manor, Rainham, Essex, **Barwyke Myrtle Leaf** 153316.

Class 195.—*British Friesian Cow, in-milk, born in 1933 or 1934, having yielded a minimum of 6,500 lb. of milk during a lactation period of 315 days.**

1st, **£20.** No. 1317.—The Trustees of Sir Alasdair W. MacRobert, Bt., Douneside, Tarland, Aboyne, Aberdeenshire, **Douneside** (imp. 1936) **Aaltje** 199808.
2nd, **£15.** No. 1318.—Albert Weightman, Middle Herrington Farm, Sunderland, **Herrington** (imp. 1936) **Corneliske** 201676.
3rd, **£10.** No. 1314.—J. H. Brown, Home Farm, Woodseaves, Stafford, **Marshgreen** (imp. 1936) **Bet** 203338 P.I.

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* 1st, 2nd and 3rd Prizes offered by the British Friesian Cattle Society.

Class 196.—*British Friesian Cow or Heifer, in-milk, born in or after* 1935.*

1st, No. 1319.—W. CURTIS & SON, Berwick Manor, Rainham, Essex, **Barwyke Butterfly** 196958.
2nd, No. 1320.—W. CURTIS & SON, Berwick Manor, **Barwyke Fokke Lilac** 196976.
3rd, No. 1322.—S. D. PLAYER, Poulton Fields, Fairford, Glos., **Ednaston Pero 9th** 200022.

Class 197.—*British Friesian Heifer, born on or between January* 1*st and June* 30*th,* 1936.

1st, No. 1330.—G. B. RADCLIFFE, Pool Bank, Tarvin, Cheshire, **Tarvin Mairschaap Irene 2nd** 218630 P.I.
2nd, No. 1333.—ALBERT WEIGHTMAN, Middle Herrington Farm, Sunderland, **Herrington Mayflower** 213784.
3rd, No. 1325.—G. J. CADDEY, Manor Farm, Egham, Surrey, **Egham Iris 4th** 212052.
4th, No. 1326.—ALFRED J. CREED, Goldicote House, Stratford-on-Avon, **Goldicote Peridot 3rd** 212986.
R.N. No. 1331.—MRS. GRAHAM REES-MOGG, Clifford Manor, Stratford-on-Avon, **Cliffordchambers Maisie** 210638.
H.C. Nos. 1324, 1329.

Class 198.—*British Friesian Heifer, born on or between July* 1*st and December* 31*st,* 1936.

1st, No. 1341.—ALBERT WEIGHTMAN, Middle Herrington Farm, Sunderland, **Herrington Maureen 2nd** 213780.
2nd, No. 1340.—G. B. RADCLIFFE, Pool Bank, Tarvin, Cheshire, **Tarvin Sunflower 5th** 218652.
3rd, No. 1338.—THE TRUSTEES OF SIR ALASDAIR W. MACROBERT, BT., Douneside, Tarland, Aboyne, Aberdeenshire, **Douneside Lod Fiona** 211820.
R.N. No. 1335.—J. LINDSAY BAILES, Pinkney Park Estate, Sherston, Malmesbury, **Hurdlesgrove Signet Briar** 214104.
H.C. Nos. 1336, 1339.

Class 199.—*British Friesian Heifer, born on or between January* 1*st and June* 30*th,* 1937.*

1st, No. 1352.—G. B. RADCLIFFE, Pool Bank, Tarvin, Cheshire, **Tarvin Arnold Irene** 231936 P.I.
2nd, No. 1353.—ALBERT WEIGHTMAN, Middle Herrington Farm, Sunderland, **Herrington Rosalind** 226598 P.I.
3rd, No. 1343.—THOMAS BROWN & SONS, The Grove, Haslington, Crewe, **Haslington Therrakke** 226390 P.I.
4th, No. 1348.—THE TRUSTEES OF SIR ALASDAIR W. MACROBERT, BT., Douneside, Tarland, Aboyne, Aberdeenshire, **Douneside Lod Beryl** 224438.
R.N. No. 1349.—THE TRUSTEES OF SIR ALASDAIR W. MACROBERT, BT., Tarland, **Douneside Lod Lorna 2nd** 224446.
H.C. No. 1344. C. Nos. 1342, 1350.

Class 200.—*British Friesian Heifer, born on or between July* 1*st and December* 31*st,* 1937.

1st, No. 1356.—THE TRUSTEES OF SIR ALASDAIR W. MACROBERT, BT., Douneside, Tarland, Aboyne, Aberdeenshire, **Douneside Lod Lilian** 224444.
2nd, No. 1361.—MRS. GRAHAM REES-MOGG, Clifford Manor, Stratford-on-Avon, **Cliffordchambers Nippy** 223132 P.I.
3rd, No. 1363.—ALBERT WEIGHTMAN, Middle Herrington Farm, Sunderland, **Herrington Rejoice** 226574 .
4th, No. 1357.—S. D. PLAYER, Poulton Fields, Fairford, Glos., **Whipling Flapper** 233274.
R.N. No. 1360.—G. B. RADCLIFFE, Pool Bank, Tarvin Cheshire, **Tarvin Mairakke 2nd** 231950 P.I.
H.C. Nos. 1354, 1358, 1359.

Ayrshires.

No. 1433.—The "Cowhill" Silver Challenge Cup for the best Ayrshire to JAMES HOWIE'S **Mains Jean 2nd.**
No. 1372.—R.N. for "Cowhill" Challenge Cup to DAVID WALLACE'S **Lessnessock Director.**
No. 1420.—The "Oldner" Silver Challenge Cup for the best Milk Recorded Cow or Heifer to JOHN CLARK'S **Dunrod Charm 4th.**
No. 1400.—R.N. for "Oldner" Challenge Cup to A. & A. KIRKPATRICK'S **Barr Obey.**

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* 1st, 2nd and 3rd Prizes offered by the British Friesian Cattle Society.

Class 201.—*Ayrshire Bull, born in or before* 1936.

1st, No. 1372.—DAVID WALLACE, Auchenbrain, Mauchline, **Lessnessock Director** 37150.
2nd, No. 1373.—HUGH WYLIE, Minsted, Midhurst, Sussex, **Drumfork Pilot** 36008.
3rd, No. 1366.—THE EXORS. OF E. GREENSHIELDS, Ivy House, East Herrington, Sunderland, **Clover Top Blue Boy** 38728.
R.N. No. 1367.—D. MACKAY, Symonds Hyde, Hatfield, Herts., **Bruchag Home Choice** 34979.

Class 202.—*Ayrshire Bull, born in* 1937.

1st, No. 1378.—ADAM W. MONTGOMERIE, Westburn Farm, Cambuslang, Glasgow, **Barwheys Sensation** 40353.
2nd, No. 1380.—W. H. SLATER, Eyton Farm, Wellington, Shropshire, **Cairnweil MacGregor.**
3rd, No. 1374.—SIR WILLIAM ALEXANDER, Marlston House, Marlston, Newbury, **Marlston Magnet.**
R.N. No. 1379.—THE COUNTESS OF SEFTON, Abbeystead, Lancaster, **Wyresdale Sheik.**

Class 203A.—*Ayrshire Cow, in-milk, born in or before* 1934.

1st, No. 1399.—JAS. HOWIE & SONS, Muirside, Dumfries, **Kirkcudbright Maud 4th** 69343.
2nd, No. 1393.—JAMES HOWIE, Eglinton Mains, Irvine, Ayrshire, **Cauldhame Cherry 6th** 60156.
3rd, No. 1383.—JOHN CLARK, Dunrod Farm, Inverkip, **Dunrod Mabel** 48165.
4th, No. 1418.—HUGH Wyllie, Minsted, Midhurst, Sussex, **Dalpeddar Winkle** 50880.
5th, No. 1391.—J. R. P. HEDLEY, Southwood Park, Basingstoke, **Compton Organdie** 50417.
R.N. No. 1388.—UNIVERSITY OF EDINBURGH (INSTITUTE OF ANIMAL GENETICS), Shothead, Balerno, Midlothian, **Auchenbrain Miss Craig 67th** 33760.

Class 203B.—*Ayrshire Cow, in-calf, born in or before* 1934.

1st, No. 1404.—D. MACKAY, Symonds Hyde, Hatfield, Herts., **Balmae Primrose 24th** 19522.
2nd, No. 1410.—D. H. SANDERSON, The Birks, Stamfordham, Newcastle-on-Tyne **Milkwell Mary 3rd** 54322.
3rd, 1400.—A. & A. KIRKPATRICK, Barr, Sanquhar, **Barr Obey** 40828.
4th, No. 1397.—JAMES HOWIE & SONS, Muirside, Dumfries, **Howie's Blossom 7th** 44125.
5th, No. 1385.—ALEXANDER COCHRANE, Nether Craig, Kilmarnock, **Cauldhame Mattie** 47342.
R.N. No. 1394.—JAMES HOWIE, Eglinton Mains, Irvine, Ayrshire, **Mains Lilac** 44637.

Class 204A.—*Ayrshire Heifer, in-milk, born in* 1935.*

1st, No. 1420.—JOHN CLARK, Dunrod Farm, Inverkip, **Dunrod Charm 4th** 65038.
2nd, No. 1428.—ROBERT DRUMMOND, Bargower, Hurlford, Kilmarnock, **Bargower Silver Bell 18th** 79272.
3rd, No. 1425.—ALEXANDER COCHRANE, Nether Craig, Kilmarnock, **Nether Craig Wilma** 72472.
4th, No. 1422.—JOHN CLARK, Dunrod Farm, Inverkip, **Dunrod Susan 6th** 65062,.
R.N. No. 1435.—GILBERT MARTIN, Barnes Farm, King's Langley, Herts., **Barnes Countess.**

Class 204B.—*Ayrshire Heifer, in-calf, born in* 1935.*

1st, No. 1433.—JAMES HOWIE, Eglinton Mains, Irvine, Ayrshire, **Mains Jean 2nd** 74018.
2nd, No. 1443.—HUGH WYLIE, Minsted, Midhurst, Sussex, **Knowe Sweet Pea 2nd** 76125.
3rd, No. 1431.—JAMES HOWIE, Eglinton Mains, Irvine, Ayrshire, **Mains Betty** 74011.
4th, No. 1437.—ADAM W. MONTGOMERIE, Westburn Farm, Cambuslang, Glasgow, **Tandle Hill Muriel** 76836.
R.N. No. 1430.—J. R. P. HEDLEY, Southwood Park, Basingstoke, **Thornhill Butterfly** 72782.

Class 205.—*Ayrshire Heifer, born in* 1936.

1st, No. 1451.—W. H. SLATER, Eyton Farm, Wellington, Shropshire, **Dornock Mains Minx** 74543.
2nd, No. 1448.—THE COUNTESS OF SEFTON, Abbeystead, Lancaster, **Millantae Muffy** 87397.
3rd, No. 1453.—HUGH WYLIE, Minsted, Midhurst, Sussex, **Minsted Baroness.**
4th, No. 1450.—W. H. SLATER, Eyton Farm, Wellington, Shropshire, **Cairnweil Lue 4th** 76076.

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* 1st, 2nd and 3rd Prizes offered by the Ayrshire Cattle Herd Book Society.

Guernseys.

No. 1458.—"Calehill" Silver Challenge Cup for the best Bull to ERIC H. ROSE'S **Leweston Rose Lad 6th.**

No. 1455.—R.N. for "Calehill" Challenge Cup to R. H. BRITTAIN'S **Valentine Souvenir de Vimiera.**

No. 1477.—Perpetual Silver Challenge Cup for the best Cow or Heifer to W. DUNKELS' **Fernhill Pretty 8th.**

No. 1493.—R. N. for Challenge Cup to A. THOMAS LOYD'S **Lockinge Flower 4th.**

No. 1475.—"Fernhill" Silver Challenge Cup for the Cow or Heifer gaining the highest number of points on Inspection, in Milking Trials and Butter Tests, to R. H. BRITTAIN'S **Gulpher Rouge.**

No. 1482.—R.N. for "Fernhill" Challenge Cup to ERIC H. ROSE'S **Leweston Wilma 2nd.**

No. 1484.—"Norsebury" Silver Challenge Cup for the Cow in Class 209 gaining a Prize or Commended Card on Inspection and to have gained an "A" Certificate in the Breed Society's Advanced Register in each three successive lactations prior to 21st June, 1938. The Cup to be awarded to the Cow showing the highest average percentage in Milk and Butterfat over the three lactations, to CAPT. L. REGINALD WAUD'S **Bradley Marigold.**

Class 206.—*Guernsey Bull, born in or before* 1935.

1st, No. 1458.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, **Leweston Rose Lad 6th** 10529.

2nd, No. 1455.—R. H. BRITTAIN, Gulpher Hall Farm, Felixstowe, **Valentine Souvenir de Vimiera** 9512.

3rd, No. 1454.—MRS. CECIL BRADSHAW, Bystock, Exmouth, Devon, **Bystock May Peridot** 11960.

R.N. No. 1456.—CAPT. COSMO DOUGLAS, Hazelby, Newbury, **Medora's Boy** 7853.

H.C. No. 1459.

Class 207.—*Guernsey Bull, born in* 1936.

1st, No. 1462.—LORD SWAYTHLING, Townhill Park, West End, Southampton, **Fernhill Kismet 10th** 12235.

2nd, No. 1460.—THE DITCHLEY PARK ESTATE CO., Ditchley, Enstone, Oxon, **Fernhill Kismet 13th** 12451.

3rd, No. 1463.—CAPT. L. REGINALD WAUD, Bradley Court, Chieveley, Newbury, **Bradley Rose Lad 8th** 12079.

R.N. No. 1461.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, **Leweston Rose Lad 16th** 12434.

Class 208.—*Guernsey Bull, born in* 1937.

1st, No. 1470.—W. DUNKELS, Fernhill Park, Windsor Forest, **Fernhill Robert 23rd** 13103.

2nd, No. 1471.—LADY RALLI, Beaurepaire Park, Basingstoke, **Furze Down Dairyman 2nd** 13185.

3rd, No. 1474.—CAPT. L. REGINALD WAUD, Bradley Court, Chieveley, Newbury, **Bradley Robert 11th** 13232.

4th, No. 1465.—R. H. BRITTAIN, Gulpher Hall Farm, Felixstowe, **Gulpher Dolly's Souvenir** 13222.

R.N. No. 1466.—R. H. BRITTAIN, Gulpher Hall Farm, **Gulpher Jolie's Souvenir** 13143.

H.C. Nos. 1469, 1472. **C.** Nos. 1464, 1468, 1473.

Class 209.—*Guernsey Cow, in-milk, born in or before* 1933.

1st, No. 1477.—W. DUNKELS, Fernhill Park, Windsor Forest, 43485 **Fernhill Pretty 8th.**

2nd, No. 1480.—A. THOMAS LOYD, Lockinge House, Wantage, 39935 **Lockinge Goldfinch 2nd.**

3rd, No. 1483.—H. B. TURNER, Malverleys, Newbury, 36276 **Malverleys May Rose.**

4th, No. 1482.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, 40929 **Leweston Wilma 2nd.**

R.N. No. 1484.—CAPT. L. REGINALD WAUD, Bradley Court, Chieveley, Newbury, 36136 **Bradley Marigold.**

H.C. No. 1475.

Class 210.—*Guernsey Cow or Heifer, in-milk, born in* 1934.*

1st, No. 1486.—W. DUNKELS, Fernhill Park, Windsor Forest, 45417 **Fernhill Starlight 5th.**

2nd, No. 1488.—LADY RALLI, Beaurepaire Park, Basingstoke, 45431 **Furze Down Lady Richmond 3rd.**

3rd, No. 1489.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, 47042 **Leweston Rosey 5th.**

R.N. No. 1485.—CAPT. COSMO DOUGLAS, Hazelby, Newbury, 44273 **Hazelby Ranee.**

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* Prizes offered by the English Guernsey Cattle Society.

Class 211.—*Guernsey Cow or Heifer, in-milk, born in* 1935.*

1st, No. 1493.—A. THOMAS LOYD, Lockinge House, Wantage, 49572 **Lockinge Flower 4th.**
2nd, No. 1491.—CAPT. COSMO DOUGLAS, Hazelby, Newbury, 47234 **Hazelby Felicity 2nd.**
3rd, No. 1490.—J. BROOKE, Clopton Hall, Wickhambrook, Newmarket, 47166 **Bealings Wild Rose 2nd.**
R.N. No. 1495.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, 48556 **Leweston May Rose 2nd.**
H.C. No. 1494.

Class 212.—*Guernsey Heifer, born in* 1936.

1st, No. 1503.—H. B. TURNER, Malverleys, Newbury, 52310 **Clara 2nd of Cloture.**
2nd, No. 1500.—W. DUNKELS, Fernhill Park, Windsor Forest, 51438 **Fernhill Rosey 3rd.**
3rd, No. 1504.—CAPT. L. REGINALD WAUD, Bradley Court, Chieveley, Newbury, 50662 **Bradley Wintergreen 6th.**
R.N. No. 1499.—CAPT. COSMO DOUGLAS, Hazelby, Newbury, 51131 **Hazelby Belladonna.**
H.C. No. 1498.

Class 213.—*Guernsey Heifer, born in* 1937.

1st, No. 1514.—H. B. TURNER, Malverleys, Newbury, 55118 **Malverleys May Rose 5th.**
2nd, No. 1509.—W. DUNKELS, Fernhill Park, Windsor Forest, 55172 **Fernhill Starlight 6th.**
3rd, No. 1511.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, 55568 **Leweston Snowdrop 3rd.**
4th, No. 1513.—THE EXORS. OF HORACE H. SCOTT, Hartwell, Hartfield, Sussex, 56150 **Hartwell Starlight.**
5th, No. 1507.—R. H. BRITTAIN, Gulpher Hall Farm, Felixstowe, 54795 **Gulpher May Rose 2nd.**
R.N. No. 1515.—H. B. TURNER, Malverleys, Newbury, 55703 **Malverleys Primrose 2nd.**
H.C. No. 1516. C. No. 1508.

Jerseys.

No. 1541.—" Meridale " Silver Challenge Cup for best Jersey Yearling Bull from recorded dam to H. S. MOUNTAIN'S **Groombridge Bellerophon.**
No. 1548.—R.N. for " Meridale " Challenge Cup to MISS G. M. YULE'S **Hanstead Lucky Lad.**
No. 1517.—English Jersey Cattle Society's Champion Prize of £5 for the best Bull to R. W. CORNELL'S **Ovaltine Wonderful Lad.**
No. 1529.—R.N. for Champion Prize of £5 to M. F. NORTH'S **Vinchelez Hero.**
No. 1571.—English Jersey Cattle Society's Champion Prize of £5 for the best Cow or Heifer to M. F. NORTH'S **Southview Olivia.**
No. 1574.—R.N. for Champion Prize of £5 to OVALTINE DAIRY FARM'S **Monomial.**
" Conyngham " Silver Challenge Cup for most points awarded in a combination of Jersey entries to OVALTINE DAIRY FARM.
R.N. for " Conyngham " Challenge Cup to M. F. NORTH.
English Jersey Cattle Society's Special Prizes for best Jersey Cows or Heifers, in-milk, bred by Exhibitor:—
No. 1588.—1st, £10 to LADY HERVEY BATHURST'S **Somborne Maiden Blonde.**
No. 1592.—2nd, £5 to OVALTINE DAIRY FARM'S **Ovaltine Liberty's Daffodil.**
No. 1604.—R.N. to M. F. NORTH'S **Loxwood Buccanette.**

Class 214.—*Jersey Bull, born in or before* 1935.

1st, No. 1517.—R. W. CORNELL, Tedfold, Billingshurst, Sussex, **Ovaltine Wonderful Lad** 18353.
2nd, No. 1519.—MRS. E. O. HAWKEY, Gainsborough House, Probus, Cornwall, **Royal Observer** 19473.
3rd, No. 1523.—G. L. SAVILL, Rapsgate Park, Cirencester, **Vinchelez Duke Charles** 20201.
R.N. No. 1524.—THE HON. MRS. ESME SMYTH, Ashton Court, Long Ashton, Bristol, **Ashcourt Brave** 19107.
H.C. Nos. 1518, 1520. C. No. 1522.

Class 215.—*Jersey Bull, born in* 1936.

1st, No. 1529.—M. F. NORTH, Loxwood House, Billingshurst, Sussex, **Vinchelez Hero** 20696.
2nd, No. 1531.—W. HUMPHRYS PRESCOTT, Highlands, Woldingham, Surrey, **Jersey Milkman's Glory of Highlands,** 19889.
3rd, No. 1530.—OVALTINE DAIRY FARM, Abbots Langley, Herts., **Ovaltine Bindleaim** 19979.

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* Prizes offered by the English Guernsey Cattle Society.

4th, No. 1526.—MRS. A. M. HALL, Shipton Court, Shipton-under-Wychwood, Oxon. **Shipton Fairy Prince** 20039.
R.N. 1528.—J. W. MCCALLUM, Grange Farm, Chartridge, Chesham, Bucks., **Chesham Honest Cute Prince** 19746.
H.C. No. 1533. C. No. 1527.

Class 216.—*Jersey Bull, born in* 1937.

1st, No. 1541.—H. S. MOUNTAIN, Groombridge Place, Groombridge, Kent, **Groombridge Bellerophon** 20377.
2nd, No. 1548.—MISS G. M. YULE, Hanstead House, Bricket Wood, St. Albans, **Hanstead Lucky Lad** 20393.
3rd, No. 1535.—R. W. CORNELL, Tedfold, Billingshurst, Sussex, **Tedfold Emperor** 20572.
4th, No. 1545.—WILLIAM E. PRESS, Wolvers, Reigate, Surrey, **Wolvers Paddy** 20611.
5th, No. 1546.—CORTLANDT TAYLOR, Platt House Farm, Wrotham, Kent, **Fairseat Democrat** 20346.
R.N. No. 1536.—MRS. A. M. HALL, Shipton Court, Shipton-under-Wychwood, Oxon., **Shipton Earl's Design** 20543.
H.C. Nos. 1538, 1540. C. Nos. 1542–1544.

Class 217.—*Jersey Cow, in-milk, born in or before* 1934.

1st, No. 1571—M. F. NORTH, Loxwood House, Billingshurst, Sussex, 18620 **Southview Olivia.**
2nd, No. 1574.—OVALTINE DAIRY FARM, Abbots Langley, Herts., 31980 **Monomial.**
3rd, No. 1560.—LADY HERVEY-BATHURST, O.B.E., Somborne Park, King's Somborne, Hants., 31933 **Longrie.**
4th, No. 1572.—OVALTINE DAIRY FARM, Abbots Langley, Herts., 31730 **Dreaming Poppy.**
5th, No. 1566.—J. W. MCCALLUM, Grange Farm, Chartridge, Chesham, Bucks., 31808 **Hauteville Orange.**
R.N. No. 1576.—OVALTINE DAIRY FARM, Abbots Langley, Herts., 35666 **Pansy of Oakdale.**
H.C. Nos. 1569, 1582. C. Nos. 1581, 1583.

Class 218.—*Jersey Heifer, in-milk, born in* 1935.

1st, No. 1588.—LADY HERVEY-BATHURST, O.B.E., Somborne Park, King's Somborne, Hants., 27351 **Somborne Maiden Blonde.**
2nd, No. 1592.—OVALTINE DAIRY FARM, Abbots Langley, Herts., 26992 **Ovaltine Liberty's Daffodil.**
3rd, No. 1590.—M. F. NORTH, Loxwood House, Billinghurst, Sussex, 35821 **Vinchele Sovereign Lady.**
R.N. No. 1593.—OVALTINE DAIRY FARM, Abbots Langley, Herts., 27002 **Ovaltiney.**
H.C. No. 1594.

Class 219.—*Jersey Heifer, in-milk, born in* 1936.*

1st, No. 1596.—MRS. A. M. HALL, Shipton Court, Shipton-under-Wychwood, 31761 **Fernside Ripple.**
2nd, No. 1595.—MRS. A. M. HALL, Shipton Court, **Rush's Lady Nixey.**
3rd, No. 1604.—M. F. NORTH, Loxwood House, Billingshurst, Sussex, 30277 **Loxwood Buccanette.**
4th, No. 1606.—OVALTINE DAIRY FARM, Abbots Langley, Herts., **Kahoka's Fairy.**
5th, No. 1611.—MRS. HAYES SADLER, Charlton Abbotts, Andoversford, Glos., 29067 **Charlton Abbotts Design.**
R.N. No. 1608.—OVALTINE DAIRY FARM, Abbots Langley, Herts., 30652 **Ovalti Wizard Dream Lady.**
H.C. Nos. 1599, 1610. C. Nos. 1602, 1609.

Class 220.—*Jersey Heifer, born in* 1937.

1st, No. 1624.—OVALTINE DAIRY FARM, Abbots Langley, Herts., 34316 **Ovaltine La Sente.**
2nd, No. 1626.—WILLIAM E. PRESS, Wolvers, Reigate, Surrey, 35242 **Wolvers Diamond Buckle 3rd.**
3rd, No. 1622.—H. E. MITCHELL, Great Pellingbridge Farm, Scaynes Hill, Sussex, 34500 **Rochette's Dolly.**
4th, No. 1627.—THE HON. MRS. ESME SMYTH, Ashton Court, Long Ashton, Bristol, 32354 **Ashcourt Dusky.**
5th, No. 1623.—M. F. NORTH, Loxwood House, Billingshurst, Sussex, 38987 **Loxwood Heirloom.**
R.N. No. 1617.—MRS. A. M. HALL, Shipton Court, Shipton-under-Wychwood, Oxon., 34639 **Shipton Queen of June.**
H.C. No. 1615. C. No. 1628.

* 1st, 2nd and 3rd Prizes offered by the English Jersey Cattle Society.

Kerries.

No. 1629.—British Kerry Cattle Society's Silver Challenge Cup for best Kerry to THE EARL OF DUNRAVEN'S **Adare Brave.**
No. 1644.—R.N. for Challenge Cup to H. E. MITCHELL'S **Barrington Black Pearl 2nd.**

Class 221.—*Kerry Bull, born in or before* 1937.

1st, No. 1629.—THE EARL OF DUNRAVEN, Adare Manor, Adare, Co. Limerick, **Adare Brave** 961.
2nd, No. 1631.—H. E. MITCHELL, Great Pellingbridge Farm, Scaynes Hill, Sussex **Barrington Curly Roland** 1023.
3rd, No. 1630.—S. R. LYSAGHT, Hazelwood, Mallow, Co. Cork, **Baunclune Thief** 2164.
R.N. No. 1632.—NEWTON R. STEEL, The Hookland Estate, Scaynes Hill, Sussex, **Hookland Foreman** 1043.
C. No. 1633.

Class 222.—*Kerry Cow, in-milk, born in or before* 1934.

1st, No. 1634.—THE EARL OF DUNRAVEN, Adare Manor, Adare, Co. Limerick, **Muckross Paragon** (5640).
2nd, No. 1636.—S. R. LYSAGHT, Hazelwood, Mallow, Co. Cork, **Callinafercy Carina** (6071).
3rd, No. 1640.—NEWTON R. STEEL, Hookland Estate, Scaynes Hill, Sussex, **Hookland Eskimo** 6125.
R.N. No. 1637.—H. E. MITCHELL, Great Pellingbridge Farm, Scaynes Hill, Sussex, **Vaddy Gairowen** 5760.
H.C. No. 1641.

Class 223.—*Kerry Heifer, in-milk, born in* 1935 *or* 1936.

1st, No. 1644.—H. E. MITCHELL, Great Pellingbridge Farm, Scaynes Hill, Sussex, **Barrington Black Pearl 2nd** 6069.
2nd, No. 1642.—THE EARL OF DUNRAVEN, Adare Manor, Adare, Co. Limerick, **Adare Amethyst 3rd** 5787.
3rd, No. 1643.—S. R. LYSAGHT, Hazelwood, Mallow, Co. Cork, **Baunclune Tern** (6340).
R.N. No. 1646.—BERTRAM W. A. WATNEY, Brookwood Corner, Holmwood, Surrey, **Brookwood Countess 13th** 5947.
H.C. No. 1645.

Dexters.

No. 1662.—Dexter Cattle Society's Silver Challenge Cup for the best Dexter to LADY LODER'S **Murrell Peach Blossom.**
No. 1667.—R.N. for Challenge Cup to MRS. ERNEST JOHNSON'S **Ashtonhayes Woodbine.**

Class 224.—*Dexter Bull, born in or before* 1936.

1st, No. 1648.—MRS. E. CARLOS CLARKE, Ellens, Rudgwick, Sussex, **Ellens Prodigy.**
2nd, No. 1650.—LADY LODER, Leonardslee, Horsham, **Chew Tiny Tim** 1217.
3rd, No. 1647.—MRS. E. CARLOS CLARKE, Ellens, Rudgwick, Sussex, **Ellens Gettysburg** 1241.
R.N. No. 1651.—THE REV. E. A. DOUGLAS MORGAN, Trefonen Rectory, Oswestry, **Trefonen Nigger.**
H.C. No. 1653.

Class 225.—*Dexter Bull, born in* 1937.

1st, No. 1655.—MRS. ERNEST JOHNSON, Ashton Hayes, Chester, **Ashtonhayes Sea Hawk.**

Class 226.—*Dexter Cow, in-milk, any age.*

1st, No. 1662.—LADY LODER, Leonardslee, Horsham, **Murrell Peach Blossom** 4777.
2nd, No. 1656.—MRS. E. CARLOS CLARKE, Ellens, Rudgwick, Sussex, **Grinstead Convolvulus 6th** 4590.
3rd, No. 1661.—LADY LODER, Leonardslee, Horsham, **Grinstead Nightingale 14th** 4757.
4th, No. 1663.—MRS. T. H. PEYTON, Leeswood Old Hall, Mold, **Bagendon Supreme 3rd** 4629.
R.N. No. 1658.—MRS. ERNEST JOHNSON, Ashton Hayes, Chester, **Benenden Beatrice 2nd** 4635.
H.C. No. 1660.

Class 227.—*Dexter Heifer, in-milk (to first calving), born in* 1935 *or* 1936.

1st, No. 1667.—MRS. ERNEST JOHNSON, Ashton Hayes, Chester, **Ashtonhayes Woodbine** 4871.

Class 228.—*Dexter Heifer, born in* 1937.*

1st, No. 1670.—MRS. ERNEST JOHNSON, Ashton Hayes, Chester, **Ashtonhayes Watercress 2nd.**
2nd, No. 1671.—RHYS LLEWELLYN, St. Fagans Court, Glamorgan, **St. Fagans Barbara.**
3rd, No. 1673.—THE REV. E. A. DOUGLAS MORGAN, Trefonen Rectory, Oswestry, **Trefonen Jasmine.**
R.N. No. 1669.—MRS. ERNEST JOHNSON, Ashton Hayes, Chester, **Ashtonhayes Patsy.**
H.C. No. 1672.

Milk Yield Classes.

Class 229.—*Dairy Shorthorn Cows or Heifers.*

1st, No. 988.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, 141421 **Aldenham Barrington Lass 7th.**
2nd, No. 997.—J. PIERPONT MORGAN, Wall Hall, 151251 **Aldenham Kirklevington Lady 6th.**
3rd, No. 987.—KING'S COLLEGE FARMS, Worlaby, Brigg, 142825 **Holmescales Meadowsweet.**
4th, No. 1006.—KING'S COLLEGE FARMS, Worlaby, 156513 **St. Clere Daffodil 20th.**

Class 230.—*Lincolnshire Red Shorthorn Cows or Heifers.*

1st, No. 1084.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Honour 2nd** (Vol. 40, p. 337).
2nd, No. 1081.—RUSSELL WOOD, Bendish, Hitchin, **Bendish Woodland Rose 9th** (Vol. 37, p. 341).
3rd, No. 1085.—RUSSELL WOOD, Bendish, **Bendish Nancy 31st** (Vol. 40, p. 363).

Class 231.—*South Devon Cows or Heifers.*

1st, No. 1120.—JOHN T. DENNIS, Winsor, Yealmpton, Devon, **Winsor Snowdrop 5th** 36895.
2nd, No. 1118.—R. W. CHAFFE, Worswell Barton, Revelstoke, Devon, **Worswell Ida 5th** 36808.

Class 232.—*Red Poll Cows or Heifers.*

1st, No. 1179.—STUART PAUL, Kirton Lodge, Ipswich, 49623 **Kirton Fantasy.**
2nd, No. 1185.—LT.-COL. SIR MERRIK R. BURRELL, BT., C.B.E., Knepp Castle Estate Office, Horsham, 51809 **Knepp Minerva 25th.**
3rd, No. 1170.—MISS M. H. BOUVERIE, O.B.E., Delapre Abbey, Northampton, 49869 **Melton Mangrove.**
4th, No. 1172.—LT.-COL. SIR MERRIK R. BURRELL, BT., C.B.E., Knepp Castle Estate Office, Horsham, 49672 **Knepp Prudence 19th.**
R.N. No. 1174.—J. G. GRAY, Coombe Abbey, Coventry, 46505 **Abbeycombe Royal Rosie 2nd.**

Class 233.—*Blue Albion Cows or Heifers.*

1st, No. 1235.—C. H. GOODWIN, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Marlene of Crossfields.**
2nd, No. 1231.—T. H. CALDERBANK, The Hall, Stow Maries, Chelmsford, **Stow Doreen** 13270.
3rd, No. 1236.—C. H. WEBSTER, Ivonbrook Farm, Grange Mill, Derby, **Ivonbrook Poppy** 13112.

Class 234.—*British Friesian Cows or Heifers.*

1st, No. 1304.—T. G. FAIRHEAD, Little Chesterford, Saffron Walden, **Bordeaux Bessie** 124048.
2nd, No. 1309.—FRANCIS N. TERRY, Chibbard, Dorchester, **Shapwick Snap** 151064.

Class 235.—*Ayrshire Cows and Heifers.*

1st, No. 1415.—W. H. SLATER, Eyton Farm, Wellington, Shropshire, **Craigley Grey 18th** 42706.
2nd, No. 1388.—UNIVERSITY OF EDINBURGH (INSTITUTE OF ANIMAL GENETICS), Shothead, Balerno, Midlothian, **Auchenbrain Miss Craig 67th** 33760.

Class 236.—*Guernsey Cows or Heifers.*

1st, No. 1475.—R. H. BRITTAIN, Gulpher Hall Farm, Felixstowe, 33137 **Gulpher Rouge.**
2nd, No. 1484.—CAPT. L. REGINALD WAUD, Bradley Court, Chieveley, Newbury, 36136 **Bradley Marigold.**
3rd, No. 1485.—CAPT. COSMO DOUGLAS, Hazelby, Newbury, 44273 **Hazelby Ranee.**

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* 1st, 2nd and 3rd Prizes offered by the Dexter Cattle Society.

4th, No. 1482.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, 44273 **Leweston Wilma 2nd.**
R.N. No. 1490.—J. BROOKE, Clopton Hall, Wickhambrook, Newmarket, 47166 **Bealings Wild Rose 2nd.**
H.C. Nos. 1477, 1489.

Class 237.—*Jersey Cows or Heifers.*

1st, No. 1554.—LORD FARINGDON, Buscot Park, Faringdon, 13680 **Madcap.**
2nd, No. 1580.—WILLIAM E. PRESS, Wolvers, Reigate, Surrey, 15033 **Wolvers Jenny.**
3rd, No. 1570.—H. S. MOUNTAIN, Groombridge Place, Groombridge, Kent, 16481 **Groombridge Thrip's Bella.**
4th, No. 1565.—A. S. LOCKWOOD, Normanby Hill, Sinnington, York, 20488 **Normanby King's Ortona.**
5th, No. 1566.—J. W. MCCALLUM, Grange Farm, Chartridge, Chesham, 31808 **Hauteville Orange.**
R.N. No. 1589.—H. S. MOUNTAIN, Groombridge Place, Groombridge, Kent, 26102 **Groombridge Recorder's Berthella.**
H.C. Nos. 1549, 1568, 1579.

Class 238.—*Kerry Cows or Heifers.*

No. 1641.—"Elmhurst" Silver Challenge Cup for the Kerry Cow gaining the highest number of points, to BERTRAM W. A. WATNEY'S **Loran Lady.**
No. 1637.—R. W. for "Elmhurst" Challenge Cup to H. E. MITCHELL'S **Vaddy Gairowen.**

1st, No. 1641.—BERTRAM W. A. WATNEY, Brookwood Corner, Holmwood, Surrey, **Loran Lady 5714.**
2nd, No. 1637.—H. E. MITCHELL, Great Pellingbridge Farm, Scaynes Hill, Sussex, **Vaddy Gairowen 5760.**
3rd, No. 1634.—THE EARL OF DUNRAVEN, Adare Manor, Adare, Co. Limerick, **Muckross Paragon (5640).**
R.N. No. 1636.—S. R. LYSAGHT, Hazelwood, Mallow, Co. Cork, **Callinaferry Carina** (6071).
H.C. No. 1640.

Class 239.—*Dexter Cows or Heifers.*

No. 1664.—Perpetual Silver Challenge Cup for the Dexter Cow gaining the highest number of points, to MRS. T. H. PEYTON'S **Colomendy Sybil.**
No. 1658.—R.N. for Challenge Cup to MRS. ERNEST JOHNSON'S **Benenden Beatrice 2nd.**

1st, No. 1664.—MRS. T. H. PEYTON, Leeswood Old Hall, Mold, **Colomendy Sybil 4661.**
2nd, No. 1658.—MRS. ERNEST JOHNSON, Ashton Hayes, Chester, **Benenden Beatrice 2nd** 4635.
3rd, No. 1660.—RHYS LLEWELLYN, St. Fagans Court, Glamorgan, **St. Fagans Angela** 4933.

Butter Tests.

No. 1304.—Champion Gold Medal for the Cow obtaining the highest number of points in the Butter Tests to T. G. FAIRHEAD'S **Bordeaux Bessie.**
No. 1554.—R.N. for Champion Gold Medal to LORD FARINGDON'S **Madcap.**

English Jersey Cattle Society's Medals for Jersey Cows obtaining the highest number of points :—
No. 1554.—Gold Medal to LORD FARINGDON'S **Madcap.**
No. 1580.—Silver Medal to WILLIAM E. PRESS' **Wolvers Jenny.**
No. 1565.—Bronze Medal to A. S. LOCKWOOD'S **Normanby King's Ortona.**

Certificates of Merit to Nos. 1568, 1570, 1589.
English Guernsey Cattle Society's Certificate of Merit to Nos. 1482, 1484, 1485, 1490.

Class 240.—*Cow of the Guernsey, Jersey, Kerry or Dexter Breed.*

1st, No. 1554.—LORD FARINGDON, Buscot Place, Faringdon, Berks., 13680 **Madcap.**
2nd, No. 1580.—WILLIAM E. PRESS, Wolvers, Reigate, Surrey, 15033 **Wolvers Jenny.**
3rd, No. 1475.—R. H. BRITTAIN, Gulpher Hall Farm, Felixstowe, 33137 **Gulpher Rouge.**
4th, No. 1565.—A. S. LOCKWOOD, Normanby Hill, Sinnington, York, 20488 **Normanby King's Ortona.**
5th, No. 1566.—J. W. MCCALLUM, Grange Farm, Chartridge, Chesham, 31808 **Hauteville Orange.**
R.N. No. 1570.—H. S. MOUNTAIN, Groombridge Place, Groombridge, Kent, 16481 **Groombridge Thrip's Bella.**
H.C. Nos. 1482, 1484, 1485, 1490, 1568, 1589.

Class 241.—*Cow of any other breed other than those mentioned in Class 240.*

1st, No. 1304.—T. G. FAIRHEAD, Little Chesterford, Saffron Walden, **Bordeaux Bessie** 124048.
2nd, No. 1120.—JOHN T. DENNIS, Winsor, Yealmpton, Devon, **Winsor Snowdrop 5th** 36895.
3rd, No. 815.—W. E. SWINNERTON, Crickley Barrow House, Northleach, **Crickley Chestnut** (Vol. 17, p. 11).
4th, No. 988.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, 141421 **Aldenham Barrington Lass 7th.**
5th, No. 1388.—UNIVERSITY OF EDINBURGH (INSTITUTE OF ANIMAL GENETICS), Shothead, Balerno, Midlothian, **Auchenbrain Miss Craig 67th** 33760.
R.N. No. 997.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, 151251 **Aldenham Kirklevington Lady 6th.**

Goats.

The Prizes for Goats are First, £5; Second, £3; Third, £2; Fourth, £1; Fifth, 10s.

£30 towards these Prizes offered by the British Goat Society.

Special Prizes offered by the British Goat Society :—

No. 1678.—Breed Challenge Certificate for the best British Toggenburg and Challenge Certificate for the best Dual Purpose Goat that has borne a Kid, to MISS E. M. GRESLEY HALL'S **Webb Demeter.**
No. 1679.—R.N. for Breed Challenge Certificate to MRS. R. K. MORCOM'S **Cornish Frisky.**
No. 1681.—Breed Challenge Certificate for the best Toggenburg to MISS E. M. SHEPPARD'S **Widdington Wintersweet.**
No. 1683.—Breed Challenge Certificate for best Saanen to MISS K. PARKER'S **Jean of Delamere.**
No. 1682.—R.N. for Breed Challenge Certificate to MISS K. PARKER'S **Jacynth of Delamere.**
No. 1691.—Breed Challenge Certificate for the best British Saanen, Bronze Medal for the best Goat, Challenge Certificate for the best Goat that has borne a Kid, R.N. for Challenge Certificate for the best Dual Purpose Goat and the "Chamberlain" Challenge Trophy for the British Saanen Goat gaining the highest number of points in Inspection and Milking to MISS M. WINDOW HARRISON'S **Humble of Weald.**

No. 1690.—R.N. for Breed Challenge Certificate and R.N. for the "Chamberlain" Challenge Trophy to MISS M. WINDOW HARRISON'S **Hartyre of Weald.**
No. 1698.—The "Abbey" Challenge Cup for the British Alpine Goat gaining the highest number of points in Inspection and Milking to MISS ALEXANDER'S **Stockwell Tzigane.**
No. 1702.—Breed Challenge Certificate for the best British Alpine, R.N. for Bronze Medal for the best Goat and R.N. for Challenge Certificate for the best Goat that has borne a Kid to MISS POPE'S **Highland Mauviette.**
No. 1699.—R.N. for Breed Challenge Certificate to J. R. EGERTON'S **Didgemere Darkalette.**
No. 1708.—Breed Challenge Certificate for the best Anglo-Nubian Goat, the "Egerton" Perpetual Challenge Trophy for the Anglo-Nubian Goat gaining the highest number of points in Inspection and Milking, and the "Pomeroy" Challenge Cup for the Anglo-Nubian Goat gaining highest points in the Quality Class to MISS K. PELLY'S **Theydon Ballaritza.**
No. 1704.—R.N. for Breed Challenge Certificate and R.N. for "Egerton" Perpetual Challenge Trophy to J. R. EGERTON'S **Malpas Merrilegs.**
No. 1711.—R.N. for the "Pomeroy" Challenge Cup to MISS K. PELLY'S **Theydon Judy.**
No. 1732.—Bronze Medal for the best Goatling to J. R. EGERTON'S **Malpas Merle.**
No. 1727.—R.N. for Bronze Medal to J. R. EGERTON'S **Twinstead Thrifty.**

The "Dewar" Challenge Cup for the Exhibitor showing a Goat in milk, and Goatling :—

Nos. 1678 and 1734.—MISS E. M. GRESLEY HALL'S **Webb Demeter** and **Webb Dakota.**
R.N. for Challenge Cup, Nos. 1691 and 1719.—MISS M. WINDOW HARRISON'S **Humble of Weald** and **Hammer of Weald.**

Class 242.—*Female Goat, in-milk, any age, entered in or eligible for the Toggenburg Section, or the British Toggenburg Section or Register of the Herd Book.*

1st, No. 1681.—MISS E. M. SHEPPARD, Thrift Wood, Great Canfield, Dunmow, **Widdington Wintersweet** 815.
2nd, No. 1678.—MISS E. M. GRESLEY HALL, Chestnut Tree House, Willersey, Broadway, Worcs., **Webb Demeter** 158.
3rd, No. 1679.—MRS. R. K. MORCOM, The Clock House, Bromsgrove, **Cornish Frisky** 1018.
R.N. No. 1680.—MRS. PAINE, Freiston Priory, Boston, Lincs., **Cornish Frolic** 1017.

Class 243.—*Female Goat, in-milk, any age, entered in or eligible for the Saanen Section of the Herd Book.*

1st, No. 1683.—MISS K. PARKER, Grove House, Tarvin, Chester, **Jean of Delamere 223.**
2nd, No. 1682.—MISS K. PARKER, Grove House, **Jacynth of Delamere 236.**
3rd, No. 1685.—MISS EMILY SKIDMORE, Ashley, Leigh, Box, Wilts, **Heddon Caroline 282.**

Class 244.—*Female Goat, in-milk, any age, entered in or eligible for the British Saanen Section or Register of the Herd Book.*

1st, No. 1691.—MISS M. WINDOW HARRISON, Yewtree Farm, North Weald, Essex, **Humble of Weald 1050.**
2nd, No. 1690.—MISS M. WINDOW HARRISON, Yewtree Farm, **Hartyre of Weald 1049.**
3rd, No. 1694.—MISS POPE, Bashley Lodge, New Milton, Hants., **Heddon Silver 1028.**
4th, No. 1692.—MRS. R. K. MARCOM, The Clock House, Bromsgrove, **Cornish Urchinette 1193.**
R.N. No. 1696.—MISS EMILY SKIDMORE, Ashley Leigh, Box, Wilts., **Heddon Sandalshoe 1299.**
H.C. No. 1689. C. No. 1697.

Class 245.—*Female Goat, in-milk, any age, entered in or eligible for the British Alpine Section or Register of the Herd Book.*

1st, No. 1702.—MISS POPE, Bashley Lodge, New Milton, Hants., **Highland Mauviette 486.**
2nd, No. 1699.—J. R. EGERTON, Tye House, Bramford, Ipswich, **Didgemere Darkalette 1050.**
3rd, No. 1700.—J. R. EGERTON, Tye House, **Malpas Mariella 494.**
R.N. No. 1698.—MISS ALEXANDER, Byards Lodge, Knaresborough, **Stockwell Tzigane 390.**

Class 246.—*Female Goat, in-milk, any age, entered in or eligible for the Anglo-Nubian Section or the Anglo-Nubian Probationer's Record of the Herd Book.*

1st, No. 1708.—MISS K. PELLY, Theydon Place, Epping, Essex, **Theydon Bellaritza 2522.**
2nd, No. 1704.—J. R. EGERTON, Tye House, Bramford, Ipswich, **Malpas Merrilegs 2423.**
3rd, No. 1706.—J. R. EGERTON, Tye House, **Malpas Musette 2489.**
4th, No. 1710.—Miss K. PELLY, Theydon Place, Epping, Essex, **Theydon Butterkin 2430.**
R.N. No. 1705.—J. R. EGERTON, Tye House, Bramford, Ipswich, **Malpas Moya 2488.**
H.C. No. 1707.

Class 247.—*Female Goat, in-milk, any age, any other variety.*

1st, No. 1715.—MRS. R. K. MORCOM, The Clock House, Bromsgrove, **Cornish Playful 11121.**
2nd, No. 1713.—J. R. EGERTON, Tye House, Bramford, Ipswich, **Malpas Meda 12679.**
3rd, No. 1716.—MRS. R. K. MORCOM, The Clock House, Bromsgrove, **Cornish Puffin 12608.**
R.N. No. 1714.—MRS. R. K. MORCOM, The Clock House, Bromsgrove, **Cornish Dizzy 12609**
H.C. No. 1717.

Class 248.—*Goatling, over 1 but not exceeding 2 years old, entered in or eligible for the Saanen Section or the British Saanen Section or Register of the Herd Book.*

1st, No. 1722.—MISS K. PELLY, Theydon Place, Epping, Essex, **Theydon Melican, 1417.**
2nd, No. 1723.—MISS EMILY SKIDMORE, Ashley Leigh, Box, Wilts, **Heddon Betty 434.**
3rd, No. 1720.—MISS K. PARKER, Grove House, Tarvin, Chester, **Rosaleen of Delamere 1396.**
R.N. No. 1719.—MISS M. WINDOW HARRISON, Yewtree Farm, North Weald, Essex, **Hammer of Weald, 1496.**

Class 249.—*Goatling, over 1 but not exceeding 2 years old, entered in or eligible for the British Alpine Section or Register of the Herd Book.*

1st, No. 1727.—J. R. Egerton, Tye House, Bramford, Ipswich, **Twinstead Thrifty 1280.**
2nd, No. 1729.—MISS POPE, Bashley Lodge, New Milton, Hants., **Prank of Bashley 548.**
3rd, No. 1725.—J. R. EGERTON, Tye House, Bramford, Ipswich, **Malpas Margaritrose 573.**
R.N. No. 1724.—MISS ALEXANDER, Byards Lodge, Knaresborough, **Stockwell Tsadvo 1298.**
H.C. No. 1728.

Class 250.—*Goatling, over 1 but not exceeding 2 years old, entered in or eligible for the Anglo-Nubian Section or the Anglo-Nubian Probationers' Record of the Herd Book.*

1st, No. 1732.—J. R. Egerton, Tye House, Bramford, Ipswich, **Malpas Merle** 2548.
2nd, No. 1731.—J. R. Egerton, Tye House, **Malpas Meriel** 2549.
3rd, No. 1733.—Miss K. Pelly, Theydon Place, Epping, Essex, **Menlo Motley** 2586.
R.N. No. 1730.—Miss K. M. Davies, Hill Crest, Northop, Flintshire, **Cambrian Candytuft** 2561.

Class 251.—*Goatling, over 1 but not exceeding 2 years old, any other variety.*

1st, No. 1734.—Miss E. M. Gresley Hall, Chestnut Tree House, Willersey, Broadway, Worcs., **Webb Dakota** 12826.
2nd, No. 1737.—Miss Pope, Bashley Lodge, New Milton, Hants., **Bitterne Belinda** 292.
3rd, No. 1735.—Mrs. R. K. Morcom, The Clock House, Bromsgrove, **Cornish Marmalade** 12846.

Class 252.—*Milk Yield, Quality.*

1st, No. 1678.—Miss E. M. Gresley Hall, Chestnut Tree House, Willersey, Broadway, Worcs., **Webb Demeter** 156.
2nd, No. 1691.—Miss M. Window Harrison, Yewtree Farm, North Weald, Essex, **Humble of Weald** 1050.
3rd, No. 1694.—Miss Pope, Bashley Lodge, New Milton, Hants., **Heddon Silver** 1028.
4th, No. 1690.—Miss M. Window Harrison, Yewtree Farm, North Weald, Essex, **Hartye of Weald** 1049.
5th, No. 1708.—Miss K. Pelly, Theydon Place, Epping, Essex, **Theydon Bellaritza** 2522.
R.N. No. 1676.—Miss E. M. Gresley Hall, Chestnut Tree House, Willersey, Broadway, Worcs., **Webb Dauphinella** 257.
H.C. Nos. 1679, 1696, 1711, 1713, 1714, 1716. **C.** Nos. 1685, 1698, 1699, 1704.

Class 253.—*Milk Yield, Quantity.*

1st, No. 1678.—Miss E. M. Gresley Hall, Chestnut Tree House, Willersey, Broadway, Worcs., **Webb Demeter** 158.
2nd, No. 1691.—Miss M. Window Harrison, Yewtree Farm, North Weald, Essex, **Humble of Weald** 1050.
3rd, No. 1717.—Mrs. Paine, Freiston Priory, Boston, Lincs., **Tamar Ruffle** 11022.
4th, No. 1694.—Miss Pope, Bashley Lodge, New Milton, Hants., **Heddon Silver** 1028.
5th, No. 1679.—Mrs. R. K. Morcom, The Clock House, Bromsgrove, **Cornish Frisky** 1018.
R.N. No. 1687.—Miss C. Chamberlain, Westons, Lyndhurst, Hants., **Whynot of Westons** 447.
H.C. Nos. 1676, 1689, 1690, 1700. **C.** Nos. 1680, 1713, 1714, 1716.

SHEEP.

The Prizes for Sheep, unless otherwise stated, are First, £10; Second, £5; Third, £3; Fourth, £2; Fifth, £1.

Oxford Downs.

No. 1740.—"Banbury" Silver Challenge Cup for the best Male Exhibit and "Birdlip" Silver Challenge Cup for best exhibit to Hugh W. Stilgoe.
No. 1755.—R.N. for "Banbury" Challenge Cup to Hobbs & Davis.
No. 1761.—"Kelmscott" Silver Challenge Cup for the best Female Exhibit and R.N. for "Birdlip" Challenge Cup for best exhibit to Hugh W. Stilgoe.
No. 1768.—R.N. for "Kelmscott" Challenge Cup to W. F. G. Watts & Sons.

Class 254.—*Oxford Down Shearling Ram.*

1st, No. 1740.—Hugh William Stilgoe, The Grounds, Adderbury, Banbury.
2nd, No. 1738.—Hugh William Stilgoe, The Grounds.
3rd, No. 1739.—Hugh William Stilgoe, The Grounds.
R.N. No. 1741.—Hugh William Stilgoe, The Grounds.

Class 255.—*Oxford Down Ram Lamb.*

1st, No. 1746.—W. R. Gantlett & Son, Manor Farm, Fairford, Glos.
2nd, No. 1747.—Hobbs & Davis, Kelmscott, Lechlade, Glos.
3rd, No. 1750.—W. F. G. Watts & Sons, Elsfield, Oxford.
4th, No. 1749.—W. F. G. Watts & Sons, Elsfield.
R.N. No. 1744.—E. G. Clifford, Manley Farm, Quenington, Fairford, Glos.
H.C. No. 1743. **C.** No. 1748.

Class 256.—*Three Oxford Down Ram Lambs.*

1st, No. 1755.—HOBBS & DAVIS, Kelmscott, Lechlade, Glos.
2nd, No. 1753.—E. G. CLIFFORD, Manley Farm, Quenington, Fairford, Glos.
3rd, No. 1754.—W. R. GANTLETT & SON, Manor Farm, Fairford, Glos.
R.N. No. 1758.—W. F. G. WATTS & SONS, Elsfield, Oxford.
H.C. No. 1757.

Class 257.—*Three Oxford Down Shearling Ewes.*

1st, No. 1761.—HUGH WILLIAM STILGOE, The Grounds, Adderbury, Banbury.
2nd, No. 1760.—MRS. A. BAZLEY, Dean Farm, Fairford, Glos.

Class 258.—*Three Oxford Down Ewe Lambs.*

1st, No. 1768.—W. F. G. WATTS & SONS, Elsfield, Oxford.
2nd, No. 1763.—E. G. CLIFFORD, Manley Farm, Quenington, Fairford, Glos.
3rd, No. 1765.—HOBBS & DAVIS, Kelmscott, Lechlade, Glos.
H.C. No. 1764. C. No. 1762.

Shropshires.

£15 towards these Prizes offered by the Shropshire Sheep Breeders' Association.

No. 1771.—Shropshire Sheep Breeders' Association's Champion Silver Medal for the best Ram or Ram Lamb and "Hardwicke" Perpetual Silver Challenge Cup for best exhibit to JOHN M. BELCHER.
No. 1779.—R.N. for Champion Silver Medal to JOHN M. BELCHER.
No. 1794.—R.N. for "Hardwicke" Challenge Cup to JOHN M. BELCHER.

Class 259.—*Shropshire Shearling Ram.*

1st, No. 1771.—JOHN M. BELCHER, Tibberton Green, Wellington, Shropshire.
2nd, No. 1777.—LT.-COL. J. N. RITCHIE, Tern, Wellington, Shropshire.
3rd, No. 1776.—LT.-COL. J. N. RITCHIE, Tern.
R.N. No. 1774.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.
H.C. Nos. 1772, 1773.

Class 260.—*Shropshire Ram Lamb.*

1st, No. 1779.—JOHN M. BELCHER, Tibberton Green, Wellington, Shropshire.
2nd, No. 1783.—LT.-COL. J. N. RITCHIE, Tern, Wellington, Shropshire.
3rd, No. 1782.—MRS. M. C. INGE, Thorpe Hall, Tamworth.
R.N. No. 1784.—LT.-COL. J. N. RITCHIE, Tern, Wellington, Shropshire.
H.C. No. 1781.

Class 261.—*Three Shropshire Shearling Rams.*

1st, No. 1785.—JOHN M. BELCHER, Tibberton Green, Wellington, Shropshire.
2nd, No. 1786.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.
3rd, No. 1788.—LT.-COL. J. N. RITCHIE, Tern, Wellington, Shropshire.
R.N. No. 1787.—MRS. M. C. INGE, Thorpe Hall, Tamworth.

Class 262.—*Three Shropshire Ram Lambs.*

1st, No. 1793.—LT.-COL. J. N. RITCHIE, Tern, Wellington, Shropshire.
2nd, No. 1792.—MRS. M. C. INGE, Thorpe Hall, Tamworth.
3rd, No. 1791.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.
R.N. No. 1789.—W. BARNETT, Wood Orchard, Audlem, Crewe.

Class 263.—*Three Shropshire Shearling Ewes.*

1st, No. 1794.—JOHN M. BELCHER, Tibberton Green, Wellington, Shropshire.
2nd, No. 1796.—MRS. M. C. INGE, Thorpe Hall, Tamworth.
3rd, No. 1797.—LT.-COL. J. N. RITCHIE, Tern, Wellington, Shropshire.
R.N. No. 1795.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.

Class 264.—*Three Shropshire Ewe Lambs.*

1st, No. 1802.—LT.-Col. J. N. Ritchie, Tern, Wellington, Shropshire.
2nd, No. 1800.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.
3rd, No. 1799.—JOHN M. BELCHER, Tibberton Green, Wellington, Shropshire.
R.N. No. 1801.—MRS. M. C. INGE, Thorpe Hall, Tamworth.

Southdowns.

No. 1805.—Southdown Sheep Society's Champion Gold Medal for the best Ram or Ram Lamb and "Northumberland" Challenge Cup for best exhibit to LADY LUDLOW'S **Luton Hoo 673 of 1936.**
No. 1819.—R.N. for Champion Gold Medal to JOHN LANGMEAD & SON.
No. 1873.—Southdown Sheep Society's Champion Silver Medal for best Pen of Ewes or Ewe Lambs and R.N. for "Northumberland" Challenge Cup to JOHN LANGMEAD & SON.
No. 1875.—R.N. for Champion Silver Medal to JOHN LANGMEAD & SON.

Class 265.—*Southdown Two-Shear Ram.*

1st, No. 1805.—LADY LUDLOW, Luton Hoo, Luton, **Luton Hoo 673 of 1936** 24424.
2nd, No. 1804.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel, **Bognor Regis Favourite.**
3rd, No. 1808.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Aldenham Basil** 24443.
4th, No. 1806.—LADY LUDLOW, Luton Hoo, Luton, **Luton Hoo 675 of 1936** 24425.
R.N. No. 1812.—HUGH WYLLIE, Minsted, Midhurst, Sussex.
H.C. No. 1807. **C.** No. 1811.

Class 266.—*Southdown Shearling Ram.*

1st, No. 1819.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
2nd, No. 1826.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford.
3rd, No. 1834.—HUGH WYLLIE, Minsted, Midhurst, Sussex.
4th, No. 1825.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford.
5th, No. 1830.—WILLIAM H. PITTS, Woodhorn, Oving, Chichester.
R.N. No. 1820.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
H.C. Nos. 1816, 1823. **C.** Nos. 1813, 1815, 1827, 1829.

Class 267.—*Southdown Ram Lamb.**

1st, No. 1849.—HUGH WYLLIE, Minsted, Midhurst, Sussex.
2nd, No. 1840.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
3rd, No. 1847.—MRS. V. G. STRIDE, Head Hone Farm, Lidsey, Bognor Regis.
4th, No. 1844.—WILLIAM H. PITTS, Woodhorn, Oving, Chichester.
5th, No. 1848.—MRS. V. G. STRIDE, Head Hone Farm, Lidsey, Bognor Regis.
R.N. No. 1841.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
H.C. Nos. 1835, 1838. **C.** No. 1839.

Class 268.—*Three Southdown Shearling Rams.**

1st, No. 1853.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
2nd, No. 1854.—LADY LUDLOW, Luton Hoo, Luton.
3rd, No. 1855.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford.
4th, No. 1858.—WILLIAM H. PITTS, Woodhorn, Oving, Chichester.
R.N. No. 1859.—MRS. V. G. STRIDE, Head Hone Farm, Lidsey, Bognor Regis.
H.C. Nos. 1850, 1856. **C.** Nos. 1851, 1852.

Class 269.—*Three Southdown Ram Lambs.*

1st, No. 1865.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
2nd, No. 1869.—WILLIAM H. PITTS, Woodhorn, Oving, Chichester.
3rd, No. 1871.—MRS. V. G. STRIDE, Head Hone Farm, Lidsey, Bognor Regis.
4th, No. 1872.—HUGH WYLLIE, Minsted, Midhurst, Sussex.
5th, No. 1861.—HIS MAJESTY THE KING, Sandringham.
R.N. No. 1866.—WILLIAM LEE, Hatch Gate Farm, Wargrave, Berks.
H.C. No. 1862. **C.** Nos. 1863, 1864, 1867, 1868.

Class 270.—*Three Southdown Shearling Ewes.*

1st, No. 1873.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
2nd, No. 1875.—JOHN LANGMEAD & SON, Northwood.
3rd, No. 1877.—LADY LUDLOW, Luton Hoo, Luton.
4th, No. 1879.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford.
R.N. No. 1884.—MRS. V. G. STRIDE, Head Hone Farm, Lidsey, Bognor Regis.
H.C. Nos. 1878, 1881. **C.** Nos. 1876, 1882.

Class 271.—*Three Southdown Ewe Lambs.*

1st, No. 1895.—HUGH WYLIE, Minsted, Midhurst, Sussex.
2nd, No. 1892.—WILLIAM H. PITTS, Woodhorn, Oving, Chichester.
3rd, No. 1889.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
4th, No. 1894.—MRS. V. G. STRIDE, Head Hone Farm, Lidsey, Bognor Regis.
R.N. No. 1886.—THE EARL OF DERBY, K.G., Hatchfield Farm, Newmarket.
H.C. No. 1890. **C.** No. 1888.

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* 1st, 2nd and 3rd Prizes offered by the Southdown Sheep Society.

Hampshire Downs.

No. 1936.—Hampshire Down Sheep Breeders' Association's Champion Prize of £10 for the best exhibit to E. CLIFTON-BROWN.
No. 1919.—R.N. for Champion Prize to PERCY C. TORY.

Class 272.—*Hampshire Down Shearling Ram.*

1st, No. 1901.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
2nd, No. 1896.—H. A. BENYON, Englefield House, Englefield, Reading.
3rd, No. 1904.—G. M. HOPE, Basildon Home Farm, Pangbourne, Berks.
4th, No. 1902.—ERNEST PERCIVAL COLEBROOK, Fox Farm, Amport, Andover.
R.N. No. 1905.—PERCY C. TORY, Shapwick, Blandford, Dorset.
C. No. 1897.

Class 273.—*Hampshire Down Ram Lamb.*

1st, No. 1919.—PERCY C. TORY, Shapwick, Blandford, Dorset.
2nd, No. 1907.—H. A. BENYON, Englefield House, Englefield, Reading.
3rd, No. 1912.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
4th, No. 1909.—MAJOR V. S. BLAND, M.C., The Warren, Aldbourne, Wilts.
5th, No. 1913.—ERNEST PERCIVAL COLEBROOK, Fox Farm, Amport, Andover.
R.N. No. 1915.—G. M. HOPE, Basildon Home Farm, Pangbourne, Berks.
H.C. Nos. 1910, 1916. **C.** No. 1920.

Class 274.—*Three Hampshire Down Ram Lambs.*

1st, No. 1923.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
2nd, No. 1929.—PERCY C. TORY, Shapwick, Blandford, Dorset.
3rd, No. 1926.—G. M. HOPE, Basildon Home Farm, Pangbourne, Berks.
R.N. No. 1922.—MAJOR V. S. BLAND, M.C., The Warren, Aldbourne, Wilts.
H.C. No. 1927. **C.** Nos. 1921, 1925.

Class 275.—*Three Hampshire Down Shearling Ewes.*

1st, No. 1931.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
2nd, No. 1930.—E. CLIFTON-BROWN, Burnham Grove.
3rd, No. 1932.—G. M. HOPE, Basildon Home Farm, Pangbourne, Berks.

Class 276.—*Three Hampshire Down Ewe Lambs.*

1st, No. 1936.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
2nd, No. 1935.—MAJOR V. S. BLAND, M.C., The Warren, Aldbourne, Wilts.
3rd, No. 1938.—G. M. HOPE, Basildon Home Farm, Pangbourne, Berks.
R.N. No. 1937.—ERNEST PERCIVAL COLEBROOK, Fox Farm, Amport, Andover.
H.C. No. 1941. **C.** Nos. 1934, 1939.

Suffolks.

No. 1950.—Suffolk Sheep Society's Perpetual Challenge Plate and £5 for the best exhibit to STUART PAUL.
No. 1977.—R.N. for Challenge Plate to JOHN R. KEEBLE & SON.

Class 277.—*Suffolk Two-Shear Ram.*

1st, No. 1945.—SIR PRINCE PRINCE-SMITH, BT., Southburn, Driffield, **Southburn Baronet 2nd 25131.**
2nd, No. 1944.—JOHN R. KEEBLE & SON, Brantham Hall, Manningtree, Essex, **Kirton Pioneer 24577.**
3rd, No. 1942.—H.M. PRISON COMMISSIONERS, Hollesley Bay Colony, Woodbridge, **Colony Sextus 24621.**

Class 278.—*Suffolk Shearling Ram.*

1st, No. 1950.—STUART PAUL, Kirton Lodge, Ipswich.
2nd, No. 1949.—JOHN R. KEEBLE & SON, Brantham Hall, Manningtree, Essex.
3rd, No. 1951.—STUART PAUL, Kirton Lodge, Ipswich.
R.N. No. 1952.—SIR PRINCE PRINCE-SMITH, BT., Southburn, Driffield.

Class 279.—*Suffolk Ram Lamb.*

1st, No. 1959.—H.M. PRISON COMMISSIONERS, Hollesley Bay Colony, Woodbridge.
2nd, No. 1961.—JOHN R. KEEBLE & SON, Brantham Hall, Mannintree, Essex.
3rd, No. 1964.—STUART PAUL, Kirton Lodge, Ipswich.
4th, No. 1966.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill.
5th, No. 1955.—THE EARL OF ELLESMERE, Stetchworth Park, Newmarket.
R.N. No. 1958.—G. A. GOODCHILD, Great Yeldham Hall, Great Yeldham, Essex.
H.C. No. 1960.

Class 280.—*Three Suffolk Ram Lambs.**

1st, No. 1977.—JOHN R. KEEBLE & SON, Brantham Hall, Manningtree, Essex.
2nd, No. 1974.—H.M. PRISON COMMISSIONERS, Hollesley Bay Colony, Woodbridge.
3rd, No. 1978.—STUART PAUL, Kirton Lodge, Ipswich.
4th, No. 1979.—SIR PRINCE PRINCE-SMITH, BT., Southburn, Driffield.
R.N. No. 1980.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill.
H.C. No. 1970.

Class 281.—*Three Suffolk Shearling Ewes.*

1st, No. 1986.—STUART PAUL, Kirton Lodge, Ipswich.
2nd, No. 1985.—JOHN R. KEEBLE & SON, Brantham Hall, Manningtree, Essex.
3rd, No. 1984.—H.M. PRISON COMMISSIONERS, Hollesley Bay Colony, Woodbridge.
R.N. No. 1987.—SIR PRINCE PRINCE-SMITH, BT., Southburn, Driffield.
H.C. No. 1983.

Class 282.—*Three Suffolk Ewe Lambs.*

1st, No. 1992.—JOHN R. KEEBLE & SON, Brantham Hall, Manningtree, Essex.
2nd, No. 1991.—H.M. PRISON COMMISSIONERS, Hollesley Bay Colony, Woodbridge.
3rd, No. 1993.—STUART PAUL, Kirton Lodge, Ipswich.
R.N. No. 1988.—THE EARL OF ELLESMERE, Stetchworth Park, Newmarket.
H.C. No. 1994.

Dorset Downs.

No. 1997.—Dorset Down Sheep Breeders' Association's Champion Prize of £10 10*s*. for the best exhibit to HOOPER BROS.
No. 2003.—R.N. for Champion Prize to MRS. LIONEL DE ROTHSCHILD.

Class 283.—*Dorset Down Ram, Shearling and upwards.*

1st, No. 1997.—HOOPER BROS., Newburgh, Winfrith, Dorchester.
2nd, No. 1996.—MRS. LIONEL DE ROTHSCHILD, Exbury House, Southampton.
3rd, No. 2001.—JOHN STRANG, Bere Regis, Wareham, Dorset.
R.N. 2000.—P. & C. SEWARD, Weston, Petersfield, Hants.

Class 284.—*Dorset Down Ram Lamb.*†

1st, No. 2003.—MRS. LIONEL DE ROTHSCHILD, Exbury House, Southampton.
2nd, No. 2010.—P. & C. SEWARD, Weston, Petersfield, Hants.
3rd, No. 2005.—HOOPER BROS., Newburgh, Winfrith, Dorchester.
4th, No. 2004.—MRS. LIONEL DE ROTHSCHILD, Exbury House, Southampton.
R.N. No. 2009.—P. & C. SEWARD, Weston, Petersfield, Hants.
H.C. No. 2012.

Class 285.—*Dorset Down Shearling Ewe.*

1st, No. 2020.—JOHN STRANG, Bere Regis, Wareham, Dorset.
2nd, No. 2013.—MRS. LIONEL DE ROTHSCHILD, Exbury House, Southampton.
3rd, No. 2016.—HOOPER BROS., Newburgh, Winfrith, Dorchester.
R.N. No. 2014.—MRS. LIONEL DE ROTHSCHILD, Exbury House, Southampton.
H.C. Nos. 2015, 2019.

Dorset Horns.

No. 2037.—The Dorset Horn Sheep Breeders' Association's Champion Prize of £5 for the best exhibit to W. RUPERT TORY.
No. 2041.—R.N. for Champion Prize to ERNEST GEORGE HEAL.

Class 286.—*Dorset Horn Ram Lamb, born on or after October 1st*, 1937.‡

1st, No. 2024.—ERNEST GEORGE HEAL, Newclose Farm, Thorley, Yarmouth, Isle of Wight.
2nd, No. 2021.—WILFRED VINCENT CAKE, Lower Burton, Dorchester.
3rd, No. 2022.—CHARLES JOCELYN HAMBRO, Hedge End, Blandford, Dorset.
R.N. No. 2023.—CHARLES JOCELYN HAMBRO, Hedge End.

Class 287.—*Two Dorset Horn Shearling Ewes, born on or after October 1st*, 1936.

1st, No. 2037.—W. RUPERT TORY, Clenstone Manor, Blandford, Dorset.
2nd, No. 2032.—ERNEST GEORGE HEAL, Newclose Farm, Thorley, Yarmouth, Isle of Wight.
3rd, No. 2036.—W. RUPERT TORY, Clenstone Manor, Blandford, Dorset.
4th, No. 2029.—WILFRED VINCENT CAKE, Lower Burton, Dorchester, Dorset.
R.N. No. 2031.—CHARLES JOCELYN HAMBRO, Hedge End, Blandford, Dorset.
H.C. No. 2033.

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* 1st, 2nd and 3rd Prizes offered by the Suffolk Sheep Society.
† 1st, 2nd and 3rd Prizes offered by the Dorset Down Sheep Breeders' Association.
‡ Prizes offered by the Dorset Horn Sheep Breeders' Association.

Class 288.—*Two Dorset Horn Ewe Lambs, born on or after October 1st,* **1937.**

1st, No. 2041.—ERNEST GEORGE HEAL, Newclose Farm, Thorley, Yarmouth, Isle of Wight.
2nd, No. 2045.—W. RUPERT TORY, Clenstone Manor, Blandford, Dorset.
3rd, No. 2038.—WILFRED VINCHET CAKE, Lower Burton, Dorchester, Dorset.
4th, No. 2039.—CHARLES JOCELYN HAMBRO, Hedge End, Blandford, Dorset.
R.N. No. 2042.—CAPT. F. NEVILL JENNINGS, Tapnell Farm, Freshwater, Isle of Wight.
H.C. No. 2046.

Wiltshire Horns.

No. 2058.—"Pytchley" Silver Challenge Cup for the best exhibit to P. L. SMITH.
No. 2047.—R.N. for "Pytchley" Challenge Cup to WILLIAM MORRIS'S **Trefor Patriot.**

Class 289.—*Wiltshire Horn Ram, Two-shear and upwards.**

1st, No. 2047.—WILLIAM MORRIS, Tarry Lane, Yelvertoft, Rugby, **Trefor Patriot** 4374.
2nd, No. 2048.—P. L. SMITH, Kislingbury Grange, Northampton, **Kislingbury Surprise** 3868.

Class 290.—*Wiltshire Horn Shearling Ram.*

1st, No. 2050.—WILLIAM MORRIS, Tarry Lane, Yelvertoft, Rugby, **Blackdown Coronation 1** 4690.
2nd, No. 2052.—P. L. SMITH, Kislingbury Grange, Northampton, **Berrywood Optimist** 4800.
3rd, No. 2051.—HUGH RICHARDS, Sandford Hall, Oswestry, **Sandford Lad** 4753.

Class 291.—*Wiltshire Horn Shearling Ewe.*

1st, No. 2058.—P. L. SMITH, Kislingbury Grange, Northampton.
2nd, No. 2059.—P. L. SMITH, Kislingbury Grange.
3rd, No. 2057.—HUGH RICHARDS, Sandford Hall, Oswestry.
R.N. No. 2055.—WILLIAM MORRIS, Tarry Lane, Yelvertoft, Rugby.

Ryelands.

No. 2071.—Challenge Cup for best Shearling Ram to DAVID J. THOMAS'S **Thomas's Victor.**
No. 2074.—R.N. for Challenge Cup to T. P. THOMAS'S **Tyncwydd Chief.**

Class 292.—*Ryeland Ram, Two-Shear and upwards.*

1st, No. 2060.—C. DRISCOLL & SON, Penback, Whitland, Carmarthen, **Penback Hope** 3470.
2nd, No. 2063.—DAVID J. THOMAS, Monachty, Abergavenny, **Thomas's Realm** 3262.
3rd, No. 2061.—HENRY MOORE, Shucknall Court, Hereford, **Shucknall Goodenough** 3430.
R.N. No. 2064.—ROBERT N. TORY, Anderson, Blandford, Dorset, **Anderson Prime** 3435.

Class 293.—*Ryeland Shearling Ram.*

1st, No. 2071.—DAVID J. THOMAS, Monachty, Abergavenny, **Thomas's Victor.**
2nd, No. 2074.—THOMAS PHILLIP THOMAS, Tyncwydd, Whitland, Carm., **Tyncwydd Chief** 3489.
3rd, No. 2073.—DAVID J. THOMAS, Monachty, Abergavenny, **Thomas's Voucher.**
4th, No. 2077.—CAPT. D. M. WILLS, Barley Wood, Wrington, Somerset, **Barleywood Scamp** 3436.
5th, No. 2070.—R. G. READER & SONS, Lower Farm, Rhoose, Glam., **Rhoose Justice.**
R.N. No. 2066.—C. DRISCOLL & SON, Penback, Whitland, Carmarthen, **Penback Venture** 3491.

Class 294.—*Three Ryeland Ram Lambs.*

1st, No. 2083.—R. G. READER & SONS, Lower Farm, Rhoose, Glam.
2nd, No. 2078.—A. E. BALDWIN, Underley, Tenbury Wells.
3rd, No. 2084.—DAVID J. THOMAS, Monachty, Abergavenny.
R.N. No. 2080.—THE EXORS. OF LORD CAWLEY, Berrington Hall, Leominster.

Class 295.—*Three Ryeland Shearling Ewes.*

1st, No. 2089.—DAVID J. THOMAS, Monachty, Abergavenny.
2nd, No. 2086.—A. E. BALDWIN, Underley, Tenbury Wells.
3rd, No. 2087.—THE EXORS. OF LORD CAWLEY, Berrington Hall, Leominster.

* Prizes offered by the Wiltshire Horn Sheep Society.

Kerry Hill (Wales).

No. 2092.—Kerry Hill (Wales) Sheep Silver Challenge Cup or the exhibit to JOHN W. OWENS' **Stockley Safeguard.**
No. 2095.—R.N. for Challenge Cup to JOHN BEAVAN'S **Winsbury Tango.**

Class 296.—*Kerry Hill (Wales) Ram, Two Shear and upwards.*

1st, No. 2092.—JOHN W. OWENS, Woodhouse, Shobdon, Leominster, **Stockley Safeguard 19394.**
2nd, No. 2090.—JOHN BEAVAN, Winsbury, Chirbury, Montgomery, **Stockley Tenor 19918.**
3rd, No. 2094.—THOMAS WILLIAMS, The Gaer, Forden, Welshpool, **Gaer Roger 19657.**
R.N. No. 2093.—H. C. PILKINGTON, Bryntanat, Llansantffraid, Mont., **Tanatside Partner 19974.**

Class 297.—*Kerry Hill (Wales) Shearling Ram.*

1st, 2095.—JOHN BEAVAN, Winsbury, Chirbury, Montgomery, **Winsbury Tango 20547.**
2nd, No. 2099.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, **Eaton Excellence 20114.**
3rd, No. 2101.—THOMAS WILLIAMS, The Gaer, Forden, Welshpool, **Gaer Showman 20151.**
R.N. No. 2097.—JOHN W. OWENS, Woodhouse, Shobdon, Leominster, **Stockley Unique 20436.**

Class 298.—*Kerry Hill (Wales) Ram Lamb.*

1st, No. 2104.—JOHN BEAVAN, Winsbury, Chirbury, Montgomery, **Winsbury Urgent.**
2nd, No. 2108.—THOMAS WILLIAMS, The Gaer, Forden, Welshpool, **Gaer Topper.**
3rd, No. 2105.—JOHN W. OWENS, Woodhouse, Shodbon, Leominster, **Stockley Vallet.**
R.N. No. 2107.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm Aldford, Chester, **Eaton Famous.**

Class 299.—*Three Kerry Hill (Wales) Shearling Ewes.*

1st, No. 2110.—JOHN W. OWENS, Woodhouse, Shobdon, Leominster.
2nd, No. 2109.—JOHN BEAVAN, Winsbury, Chirbury, Montgomery.
3rd, No. 2111.—H. C. PILKINGTON, Bryntanat, Llansantffraid, Mont.
R.N. No. 2113.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester.

Class 300.—*Three Kerry Hill (Wales) Ewe Lambs.**

1st, No. 2115.—JOHN W. OWENS, Woodhouse, Shobdon, Leominster.
2nd, No. 2118.—THOMAS WILLIAMS, The Gaer, Forden, Welshpool.
3rd, No. 2114.—JOHN BEAVAN, Winsbury, Chirbury, Montgomery.
R.N. No. 2116.—H. C. PILKINGTON, Bryntanat, Llansantffraid, Mont.

Clun Forest.

Class 301.—*Clun Forest Ram, Two-Shear and upwards.*

1st, No. 2121.—T. E. GWILLIM, Ffostill, Talgarth, Brecon, **Bedstone Major 3490.**
2nd, No. 2122.—D. POWELL, Lower Kimbolton, Leominster, **Gamester No. 1.**
3rd, No. 2120.—T. R. ECKLEY, Court Llacca, Brecon, **Wall End A,4 3443.**
R.N. No. 2119.—DAVIES BROS., Fields End, Weobley, Hereford, **Bucknell Lieutenant 3183.**

Class 302.—*Clun Forest Shearling Ram.*

1st, No. 2127.—MISS EILEEN A. L. ROSSITER, Glen Alva, Ewyas Harold, Pontrilas Herefordshire, **Ffostill Ideal.**
2nd, No. 2125.—T. E. GWILLIM, Ffostill, Talgarth, Brecon, **Ffostil Imp.**
3rd, No. 2124.—DAVIES BROS., Fields End, Weobley, Hereford, **Fields End H.6.**
R.N. No. 2126.—D. POWELL, Lower Kimbolton, Leominster, **Mimic No. 2.**

Class 303.—*Clun Forest Ram Lamb.*

1st, No. 2132.—T. E. GWILLIM, Ffostill, Talgarth, Brecon, **Ffostill Jester.**
2nd, No. 2129.—DAVIES BROS., Fields End, Weobley, Hereford.
3rd, No. 2130.—T. R. ECKLEY, Court Llacca, Brecon, **Court Llacca C.3.**
R.N. No. 2131.—T. E. GWILLIM, Ffostill, Talgarth, Brecon, **Ffostill Jolly.**

Class 304.—*Clun Forest Shearling Ewe.*

1st, No. 2137.—T. E. GWILLIM, Ffostill, Talgarth, Brecon.
2nd, No. 2140.—MISS EILEEN A. L. ROSSITER, Glen Alva, Ewyas Harold, Pontrilas, Herefordshire.
3rd, No. 2138.—D. POWELL, Lower Kimbolton, Leominster.
R.N. No. 2136.—T. R. ECKLEY, Court Llacca, Brecon.

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* Prizes offered by the Kerry Hill (Wales) Flock Book Society.

Class 305.—*Clun Forest Ewe Lamb.**

1st, No. 2143.—Davies Bros., Fields End, Weobley, Hereford.
2nd, No. 2146.—D. Powell, Lower Kimbolton, Leominster.
3rd, No. 2145.—T. E. Gwillim, Ffostill, Talgarth, Brecon.
R.N. No. 2144.—T. R. Eckley, Court Llacca, Brecon.

Lincoln.

No. 2154.—Lincoln Longwool Sheep Breeders' Association's Special Prize of £5 for the best Shearling Ram to Clifford Nicholson.
No. 2153.—R.N. for Special Prize to Clifford Nicholson.

Class 306.—*Lincoln Shearling Ram.*

1st, No. 2154.—Clifford Nicholson, Willoughton Manor, Lincoln.
2nd, No. 2153.—Clifford Nicholson, Willoughton Manor.
3rd, No. 2149.—Ernest Addison, Riby Grange, Grimsby.

Class 307.—*Three Lincoln Shearling Rams.*

1st, No. 2158.—Daniel Fred Browett, Frith Farm, Little Casterton, Stamford.
2nd, No. 2156.—Ernest Addison, Riby Grange, Grimsby.
3rd, No. 2162.—Clifford Nicholson, Willoughton Manor, Lincoln.

Class 308.—*Three Lincoln Ram Lambs.*

1st, No. 2165.—Ernest Addison, Riby Grange, Grimsby.
2nd, No. 2168.—Clifford Nicholson, Willoughton Manor, Lincoln.
3rd, No. 2166.—Daniel Fred Browett, Frith Farm, Little Casterton, Stamford.

Class 309.—*Three Lincoln Ewe Lambs.*

1st, No. 2172.—Clifford Nicholson, Willoughton Manor, Lincoln.
2nd No. 2170. Ernest Addison, Riby Grange, Grimsby.
3rd, No. 2171. Daniel Fred Browett, Frith Farm, Little Casterton, Stamford.

Leicesters.

No. 2175.—Leicester Sheep Breeders' Association's Champion Prize for best exhibit to Exors. of R. H. Stocks.
No. 2179.—R.N. for Champion Prize to Exors. of R. H. Stocks.

Class 310.—*Leicester Shearling Ram.*

1st, No. 2175.—The Exors. of R. H. Stocks, Haywold, North Dalton, Driffield.
2nd, No. 2176.—The Exors. of R. H. Stocks, Haywold.
3rd, No. 2174.—C. E. Simpson, Hemsworth Farm, Huggate, York.

Class 311.—*Leicester Ram Lamb.*

1st, No. 2179.—The Exors. of R. H. Stocks, Haywold, North Dalton, Driffield.
2nd, No. 2177.—Arthur W. Foster, Harton Manor, Barton-le-Willows, York.
3rd, No. 2178.—The Exors. of R. H. Stocks, Haywold, North Dalton, Driffield.

Class 312.—*Leicester Ewe Lamb.*

st, No. 2182.—The Exors. of R. H. Stocks, Haywold, North Dalton, Driffield.
2nd, No. 2181.—The Exors. of R. H. Stocks, Haywold.
3rd, No. 2180.—Arthur W. Foster, Harton Manor, Barton-le-Willows, York.

Border Leicesters.

No. 2198.—Society of Border Leicester Sheep Breeders' Perpetual Silver Challenge Cup for the best Ram or Ewe to Wm. Gilchrist Macbeth.
No. 2208.—R.N. for Challenge Cup to Col. E. W. S. Balfour, D.S.O., O.B.E., M.C.

Class 313.—*Border Leicester Ram, Two-Shear and upwards.*

1st, No. 2188.—Wm. Gilchrist Macbeth, Dunira, Comrie, Perthshire, **Bonnie Boy 11036**.
2nd, No. 2186.—Donald Cross, Knockdon, Maybole, Ayrshire, **Reveille 11290.**
3rd, No. 2185.—Robert C. Cameron, Greenlawdean, Greenlaw, Berwickshire, **Coming Event 11501.**

* Prizes offered by the Clun Forest Sheep Breeders' Association.

Class 314.—*Border Leicester Shearling Ram.*

1st, No. 2198.—Wm. Gilchrist Macbeth, Dunira, Comrie, Perthshire.
2nd, No. 2197.—Donald Cross, Knockdon, Maybole, Ayrshire.
3rd, No. 2192.—Col. E. W. S. Balfour, D.S.O., O.B.E., M.C., Balbirnie, Markinch, Fife.
4th, No. 2199.—Wm. Gilchrist Macbeth, Dunira, Comrie, Perthshire.
R.N. 2193.—Robert C. Cameron, Greenlawdean, Greenlaw, Berwickshire.

Class 315.—*Border Leicester Ewe, Two-Shear and upwards.**

1st, No. 2201.—Col. E. W. S. Balfour, D.S.O., O.B.E., M.C., Balbirnie, Markinch, Fife.
2nd, No. 2204.—Donald Cross, Knockdon, Maybole, Ayrshire.
3rd, No. 2202.—Col. E. W. S. Balfour, D.S.O., O.B.E., M.C., Balbirnie. Markinch, Fife.
R.N. No. 2205.—Wm. Gilchrist Macbeth, Dunira, Comrie, Perthshire.

Class 316.—*Border Leicester Shearling Ewe.*

1st, No. 2208.—Col. E. W. S. Balfour, D.S.O., O.B.E., M.C., Balbirnie, Markinch, Fife.
2nd, No. 2211.—Wm. Gilchrist Macbeth, Dunira, Comrie, Perthshire.
3rd, No. 2207.—Col. E. W. S. Balfour, D.S.O., O.B.E., M.C., Balbirnie, Markinch, Fife.
R.N. No. 2209.—Robert C. Cameron, Greenlawdean, Greenlaw, Berwickshire.

Wensleydales.

No. 2214.—Wensleydale Longwool Sheep Breeders' Association's Silver Challenge Trophy for the best exhibit to John Dargue's **Burneside Supreme.**
No. 2224.—R.N. for Challenge Trophy to John Percival.

Class 317.—*Wensleydale Ram, Two-Shear and upwards.*

1st, No. 2214.—John Dargue, Burneside Hall, Kendal, **Burneside Supreme** 4121.
2nd, No. 2215.—John Dargue, Burneside Hall, **Easthouse Blue Prince** 4135.
3rd, No. 2217.—John Percival, Easthouse, Carperby, Leyburn, Yorks., **Burneside Goldfinder** 4167.

Class 318.—*Wensleydale Shearling Ram.*

1st, No. 2219.—John Dargue, Burneside Hall, Kendal.
2nd, No. 2222.—John Percival, Easthouse, Carperby, Leyburn, Yorks.
3rd, No. 2218.—John Dargue, Burneside Hall, Kendal.

Class 319.—*Three Wensleydale Shearling Rams.*

1st, No. 2224.—John Percival, Easthouse, Carperby, Leyburn, Yorks.
2nd, No. 2223.—John Dargue, Burneside Hall, Kendal.
3rd, No. 2225.—John Percival, Easthouse, Carperby, Leyburn, Yorks.

Class 320.—*Wensleydale Shearling Ewe.*

1st, No. 2227.—John Dargue, Burneside Hall, Kendal.
2nd, No. 2226.—John Dargue, Burneside Hall.
3rd, No. 2230.—John Percival, Easthouse, Carperby, Leyburn, Yorks.

Class 321.—*Wensleydale Yearling Ewe shown in Wool.*†

1st, No. 2234.—John Percival, Easthouse, Carperby, Leyburn, Yorks.
2nd, No. 2232.—T. B. Earle, Bolton Grange, Scorton, Richmond, Yorks.
3rd, No. 2231.—John Dargue, Burneside Hall, Kendal.

Kent or Romney Marsh.

No. 2248.—Kent or Romney Marsh Sheep Breeders' Association's Champion Prize of £6 10*s.* for the best Ram to J. Egerton Quested.
No. 2247.—R.N. for Champion Prize to J. Egerton Quested.
No. 2264.—Kent or Romney Marsh Sheep Breeders' Association's Champion Prize of £6 10*s.* for the best Pen of Ewes or Ewe Lambs to J. Egerton Quested.
No. 2262.—R.N. for Champion Prize to P. Hickman.

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* Prizes offered by the Society of Border Leicester Sheep Breeders.
† Prizes offered by the Wensleydale Longwool Sheep Breeders' Association.

Class 322.—*Kent or Romney Marsh Two-Shear Ram.*

1st, No. 2236.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln, **Horkstow Manor No. 262 of 1936** 81982.
2nd, No. 2238.—J. EGERTON QUESTED, The Firs, Cheriton, Kent, **Quested's 235 of 1936** 81262.
3rd, No. 2235.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln, **Horkstow Manor No. 30 of 1936** 81904.
R.N. No. 2237.—J. EGERTON QUESTED, The Firs, Cheriton, Kent, **Quested's 122 of 1936** 81187.

Class 323.—*Kent or Romney Marsh Shearling Ram.*

1st, No. 2248.—J. EGERTON QUESTED, The Firs, Cheriton, Kent.
2nd, No. 2247.—J. EGERTON QUESTED, The Firs.
3rd, No. 2246.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
4th, No. 2245.—CLIFFORD NICHOLSON, Willoughton Manor.
R.N. No. 2240.—E. W. BAKER, Parsonage Farm, Bekesbourne, Canterbury.
H.C. Nos. 2239, 2244, 2249.

Class 324.—*Three Kent or Romney Marsh Shearling Rams.**

1st, No. 2253.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
2nd, No. 2255.—J. EGERTON QUESTED, The Firs, Cheriton, Kent.
3rd, No. 2254.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
R.N. No. 2251.—E. W. BAKER, Parsonage Farm, Bekesbourne, Canterbury.
H.C. No. 2257. **C.** No. 2252.

Class 325.—*Three Kent or Romney Marsh Ram Lambs.*

1st, No. 2259.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
2nd, No. 2260.—J. EGERTON QUESTED, The Firs, Cheriton, Kent.
3rd, No. 2258.—P. HICKMAN, Pett Farm, Charing, Kent.
R.N. No. 2261.—ASHLEY STEVENS, Davington Hall, Faversham, Kent.

Class 326.—*Three Kent or Romney Marsh Shearling Ewes.*

1st, No. 2264.—J. EGERTON QUESTED, The Firs, Cheriton, Kent.
2nd, No. 2262.—P. HICKMAN, Pett Farm, Charing, Kent.
3rd, No. 2265.—ASHLEY STEVENS, Davington Hall, Faversham, Kent.
R.N. No. 2263.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.

Class 327.—*Three Kent or Romney Marsh Ewe Lambs.*

1st, No. 2267.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
2nd, No. 2266.—P. HICKMAN, Pett Farm, Charing, Kent.
3rd, No. 2268.—J. EGERTON QUESTED, The Firs, Cheriton, Kent.
R.N. No. 2269.—ASHLEY STEVENS, Davington Hall, Faversham, Kent.

Devon Long-Wools.

Class 328.—*Devon Long-Wool Shearling Ram.*

1st, No. 2270.—ROBERT LAWRENCE, Rull, Cullompton, Devon.
2nd, No. 2271.—WILLIAM M. SNELL, Orway, Kentisbeare, Cullompton, Devon, **Orway Curly Coat.**
3rd, No. 2272.—M. H. WATTS & SON, Knowle, Okehampton, Devon.

Class 329.—*Devon Long-Wool Shearling Ewe.*

1st, No. 2273.—ROBERT LAWRENCE, Rull, Cullompton, Devon.
2nd, No. 2274.—WILLIAM M. SNELL, Orway, Kentisbeare, Cullompton, Devon.
3rd, No. 2275.—M. H. WATTS & SON, Knowle, Okehampton, Devon.

Devon Close-Wools.

Class 330.—*Devon Close-Wool Ram, Shearling and upwards.*

1st, No. 2277.—ALFRED RICHARD LERWILL, Maddox Down, East Down, Barnstaple.
2nd, No. 2278.—A. PARKHOUSE & SONS, Holwell, East Down, Barnstaple.
3rd, No. 2276.—A. W. FRIEND & SONS, Brightlycott, Barnstaple.

Class 331.—*Devon Close-Wool Shearling Ewe.*

1st, No. 2281.—A. PARKHOUSE & SONS, Holwell, East Down, Barnstaple.
2nd, No. 2282.—F. H. K. SNELL, Buzzacott, Combe Martin, Devon.
3rd, No. 2279.—A. W. FRIEND & SONS, Brightlycott, Barnstaple.
R.N. No. 2280.—ALFRED RICHARD LERWILL, Maddox Down, East Down, Barnstaple.

* Prizes offered by the Kent or Romney Marsh Sheep Breeders' Association.

South Devons.

Class 332.—*South Devon Shearling Ram.*

1st, No. 2286.—William Hawke, Besoughan, Colan, St. Columb.
2nd, No. 2285.—J. N. Grose, Penare, Gorran, Cornwall.
3rd, No. 2284.—W. F. R. Bice, Nanswhyden, St. Columb.

Class 333.—*South Devon Shearling Ewe, shown in Wool.*

1st, No. 2287.—W. F. R. Bice, Nanswhyden, St. Columb.
2nd, No. 2288.—J. N. Grose, Penare, Gorran, Cornwall.
3rd, No. 2289.—William Hawke, Besoughan, Colan, St. Columb.

Dartmoors.

Class 334.—*Dartmoor Ram, Shearling and upwards, shown out of wool.*

1st, No. 2291.—Richard Palmer Luce, Chaddlehanger, Tavistock, **Chaddlehanger Nimble.**
2nd, No. 2292.—William John Sprague, Brinning Farm, Moretonhampstead, **Sherford** 5364.
3rd, No. 2290.—Richard Palmer Luce, Chaddlehanger, Tavistock, **Chaddlehanger Nuisance.**

Class 335.—*Dartmoor Shearling Ewe, shown in Wool.*

1st, No. 2297.—William John Sprague, Brinning Farm, Moretonhampstead.
2nd, No. 2293.—J. H. Cole, Chaddlehanger, Tavistock.
3rd, No. 2295.—Richard Palmer Luce, Chaddlehanger, Tavistock.
R.N. No. 2296.—W. H. Neal, Walreddon Farm, Tavistock.
H.C. No. 2294.

Cheviots.

Classes 336 and 337.

[No Entry.]

Welsh Mountain.

Class 338.—*Welsh Mountain Ram, Two-Shear and upwards.*

1st, No. 2306.—W. Roberts, Tregynan Ucha, Llanrhystyd, Aberystwyth, **Brynowen K.6** 6325.
2nd, No. 2307.—University College of North Wales, Bangor, **Snowdon K.33** 6067.
3rd, No. 2302.—William Petherick, Ffynon Fedw, Velindre, Morriston, Swansea, **Bill** 5944.
4th, No. 2299.—John Lockett, Maesmor Hall, Maerdy, Corwen, **Cegin J.3** 5681.
R.N. No. 2304.—Major Eric J. W. Platt, Madryn Farm, Aber, **Madryn K.1** 5949.
H.C. No. 2308. **C.** Nos. 2301, 2305.

Class 339.—*Welsh Mountain Shearling Ram.*

1st, No. 2319.—Thomas Price Thomas, Belfont, Sennybridge, Brecon, **Glasfynydd L.1** 6439.
2nd, No. 2321.—University College of North Wales, Bangor, **Snowdon L.42.**
3rd, No. 2312.—John Lockett, Maesmor Hall, Maerdy, Corwen, **Penywern L.4** 6315.
4th, No. 2318.—G. J. Thomas, Carreg Cegin, Llandilo, Carmarthen, **Cegin L.14.**
5th, No. 2322.—Rhys Williams, Tairmeibion Farm, Aber, **Arllen L.9.**
R.N. No. 2311.—Llysfasi Farm Institute, Ruthin, **Llysfasi L.7.**
H.C. No. 2317. **C.** No. 2310.

Class 340.—*Welsh Mountain Ram Lamb.*

1st, No. 2333.—G. J. Thomas, Carreg Cegin, Llandilo.
2nd, No. 2324.—David Hugh Lloyd, Cildaugoed, Tremeirchion, St. Asaph.
3rd, No. 2328.—Major Eric J. W. Platt, Madryn Farm, Aber.
4th, No. 2336.—University College of North Wales, Bangor.
5th, No. 2332.—W. Roberts, Tregynan Ucha, Llanrhystyd, Aberystwyth.
R.N. No. 2323.—David Hugh Lloyd, Cildaugoed, Tremeirchion, St. Asaph.
H.C. No. 2327. **C.** No. 2337.

Class 341.—*Three Welsh Mountain Ewes that have reared Lambs in* 1938.*

1st, No. 2341.—William Petherick, Ffynnon Fedw, Velindre, Morriston, Swansea.
2nd, No. 2344.—W. Roberts, Tregynan Ucha, Llanrhystyd, Aberstwyth.
3rd, No. 2346.—University College of North Wales, Bangor.
4th, No. 2340.—Llysfasi Farm Institute, Ruthin.
R.N. No. 2338.—H. Jones-Griffith, Wig, Aber, born in 1935.
H.C. No. 2343. **C.** No. 2342.

* 1st, 2nd and 3rd Prizes offered by the Welsh Mountain Sheep Flock Book Society.

Class 342.—*Three Welsh Mountain Shearling Ewes.*

1st, No. 2359.—University College of North Wales, Bangor.
2nd, No. 2353.—William Petherick, Ffynnon Fedw, Velindre, Morriston, Swansea.
3rd, No. 2358.—G. J. Thomas, Carreg Cegin, Llandilo.
4th, No. 2354.—Major Eric J. W. Platt, Madryn Farm, Aber.
5th, No. 2349.—Llysfasi Farm Institute, Ruthin.
R.N. No. 2350.—Llysfasi Farm Institute, Ruthin.
H.C. No. 2361. C. No. 2362.

Class 343.—*Three Welsh Mountain Ewe Lambs.*

1st, No. 2366.—Major Eric J. W. Platt, Madryn Farm, Aber.
2nd, No. 2368.—W. Roberts, Tregynan Ucha, Llanrhystyd, Aberystwyth.
3rd, No. 2369.—G. J. Thomas, Carreg Cegin, Llandilo.
4th, No. 2371.—Rhys Williams, Tairmeibion Farm, Aber.
R.N. No. 2367. Johnny Price, Tanyfedw, Sennybridge, Brecon.
H.C. No. 2363. C. No. 2370.

Black Welsh Mountain.

Class 344.—*Black Welsh Mountain Shearling Ram.*

1st, No. 2376.—Major J. A. Herbert, M.P., Llanover, Abergavenny, **Llanover Nonpareil.**
2nd, No. 2378.—R. Ewart Owen, Tanlan Hall Home Farm, Prestatyn, **Bryn 2nd.**
3rd, No. 2375.—Major J. A. Herbert, M.P., Llanover, Abergavenny, **Llanover Noble.**
R.N. No. 2374.—Mrs. Peter Clowes, Burton Court, Leominster, **Burton Bertram.**
H.C. No. 2372. C. No. 2377.

Class 345.—*Black Welsh Mountain Ram Lamb.*

1st, No. 2384.—Major J. A. Herbert, M.P., Llanover, Abergavenny.
2nd, No. 2385.—R. Ewart Owen, Tanlan Hall Home Farm, Prestatyn.
3rd, No. 2379.—The Hon. Mrs. C. Behrens, Swinton Grange, Malton, Yorks.
R.N. No. 2382.—Mrs. Peter Clowes, Burton Court, Leominster.
H.C. No. 2381. C. Nos. 2380, 2383.

Class 346.—*Three Black Welsh Mountain Shearling Ewes.**

1st, No. 2390.—Major J. A. Herbert, M.P., Llanover, Abergavenny.
2nd, No. 2391.—Major J. A. Herbert, M.P., Llanover.
3rd, No. 2386.—The Hon. Mrs. C. Behrens, Swinton Grange, Malton, Yorks.
R.N. No. 2388.—Mrs. Peter Clowes, Burton Court, Leominster.
H.C. No. 2392. C. No. 2387.

Class 347.—*Three Black Welsh Mountain Ewe Lambs.*

1st, No. 2398.—Major J. A. Herbert, M.P., Llanover, Abergavenny.
2nd, No. 2399.—R. Ewart Owen, Tanlan Hall Home Farm, Prestatyn.
3rd, No. 2393.—The Hon. Mrs. C. Behrens, Swinton Grange, Malton, Yorks.
R.N. No. 2395.—Mrs. Peter Clowes, Burton Court, Leominster.
H.C. No. 2396. C. No. 2394.

PIGS.

The Prizes for Pigs are: First, £10; Second, £5; Third, £3; Fourth, £2; Fifth, £1.

(*The numbers in brackets refer to the Tattoo or Ear Numbers of the Animals.*)

Large Whites.

No. 2413.—N.P.B.A. Champion Gold Medal for the best Boar to Frank Sainsbury's **Wratting King David 34th.**
No. 2407.—R.N. for Champion Gold Medal to J. Pierpont Morgan's **Aldenham Bradbury 54th.**
No. 2508.—N.P.B.A. Champion Gold Medal for best Sow and Challenge Cup for the best Pig to Lord Daresbury's **Walton Lassie 112th.**
No. 2539.—R.N. for Champion Gold Medal and R.N. for Challenge Cup for the best Pig to W. W. Ryman's **Wall Mana 18th.**

N.P.B.A. Special Prizes for best groups of Large White Pigs bred by Exhibitor:—

1st, **£10.** Nos. 2451, 2493, 2539, 2571.—W. W. Ryman's **Wall Majestic 53rd, Wall Lion 122nd, Wall Mana 18th and Wall Brocade 12th.**
2nd, **£5.** Nos. 2429, 2519, 2543, 2610.—A. W. White's **Spalding Prince George 20th, Spalding Reine 52nd, Spalding Queen 24th and Spalding Queen 39th.**

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* Offered by the Black Welsh Mountain Sheep Breeders' Association.

Class 348.—*Large White Boar, born in or before* 1936.

1st, No. 2413.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting King David 34th** 102243 (W. 358).
2nd, No. 2407.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Aldenham Bradbury 54th** 87141 (500).
3rd, No. 2405.—ROWLAND P. HAYNES, Delves Green Farm, Walsall, **Packwood King David C.M.** 100439 (5101).
4th, No. 2406.—HERBERT JACKSON, Chowley Oak Farm, Handley, Chester, **Walton Bradbury 32nd** 101787 (5729).
5th, No. 2403.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, **Whittingham Hercules 15th** 106935 (4659).
R.N. No. 2414.—E. TOMLINSON & SON, Hutton Wandesley, Marston, York, **Tockwith Champion Boy** 106223 (6034).
H.C. Nos. 2404, 2409.

Class 349.—*Large White Boar, born in* 1937, *before July 1st.*

1st, No. 2420.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Royal Waterman** (S. 998).
2nd, No. 2424.—W. W. RYMAN, Manor and Pipe Place Farms, Wall, Lichfield, **Wall King David 91st** 106507 (7883).
3rd, No. 2423.—MAURICE MONK, High Street, Barry, Glam., **Adderley Majesty 40th** (1437).
4th, No. 2419.—MISS M. H. BOUVERIE, O.B.E., Delapre Abbey, Northampton, **Delapre Yeoman 6th** 103773 (830).
5th, No. 2429.—ALFRED W. WHITE, Hillegom, Spalding, **Spalding Prince George 20th** 105993 (7026).
R.N. No. 2428.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Histon Basil 31st** (228).
H.C. Nos. 2426, 2427, 2431.

Class 350.—*Large White Boar, born in* 1937, *on or after July 1st.**

1st, No. 2436.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, **Walton King David 107th** (6699).
2nd, No. 2451.—W. W. RYMAN, Manor and Pipe Place Farms, Wall, Lichfield, **Wall Majestic 53rd** (8158).
3rd, No. 2441.—ROWLAND P. HAYNES, Delves Green Farm, Walsall, **Trewithen King David 8th** (253).
4th, No. 2443. G. H. JOHNSTONE, Trewithen, Grampound Road, Cornwall, **Trewithen King David 4th** (242).
5th, No. 2445.—ALFRED LEWIS, Panworth Hall, Ashill, Thetford, **Westacre Kingmaker 71st** (7689).
R.N. No. 2433.—CAVAGHAN & GRAY, LTD., Harraby, Carlisle, **Harraby King David 12th** (338).
H.C. No. 2459.

Class 351.—*Large White Boar, born in* 1938.

1st, No. 2493.—W. W. RYMAN, Manor and Pipe Place Farms, Wall, Lichfield, **Wall Lion 122nd** (8338).
2nd, No. 2487.—ALFRED LEWIS, Panworth Hall, Ashill, Thetford, **Westacre Kingmaker 100th** (7819).
3rd, No. 2476.—D. R. DAYBELL & SON, Bottesford, Nottingham, **Bottesford King David 8th** (937).
4th, No. 2499.—ALFRED W. WHITE, Hillegom, Spalding, **Spalding Prince George 29th** (8019).
5th, No. 2474.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, **Walton King David 108th** (6953).
R.N. No. 2481.—ERNEST HARDING, Packwood Grange, Dorridge, Birmingham, **Packwood Prince Basil 5th** (8016).
H.C. Nos. 2466, 2485.

Class 352.—*Large White Breeding Sow, born in or before* 1936.

1st, No. 2508.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, **Walton Lassie 112th** 265476 (5148).
2nd, No. 2505.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Dainty Girl 364th** 260480 (S. 426).
3rd, No. 2511.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Tring Superior 19th** 276604 (485).
4th, No. 2507.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, **Walton Blackberry 4th** 252178 (4701).
5th, No. 2519.—ALFRED W. WHITE, Hillegom, Spalding, **Spalding Reine 52nd** 263826 (6003).
R.N. No. 2512.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Watford Dainty Girl 6th** 277232 (376).

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* 1st, 2nd and 3rd Prizes offered by the National Pig Breeders' Association.

Class 353.—*Large White Sow, born in* 1937, *before July 1st.*

1st, No. 2539.—W. W. RYMAN, Manor and Pipe Place Farms, Wall, Lichfield, **Wall Mana 18th 276854 (7903).**
2nd, No. 2533.—ALFRED LEWIS, Panworth Hall, Ashill, Thetford, **Westacre Dainty Girl 74th 277438 (7403).**
3rd, No. 2543.—ALFRED W. WHITE, Hillegom, Spalding, **Spalding Queen 24th** 275586 (7035).
4th, No. 2535.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Aldenham Carillon 4th** 267906 (2006).
5th, No. 2538.—JAMES RUDDIN, St. John's Market, Liverpool, **Knipton Queen Mary 2nd** 272776 (194).
R.N. No. 2527.—ERNEST A. CROOKES, Rosene House Farm, Cutthorpe, Chesterfield, **Cutthorpe Queen 158th** 270258 (5102).
H.C. No. 2536. C. No. 2541.

Class 354.—*Large White Sow, born in* 1937, *on or after July 1st.*

1st, No. 2571.—W. W. RYMAN, Manor and Pipe Place Farms, Wall, Lichfield, **Wall Brocade 12th** (8143).
2nd No. 2572.—W. W. RYMAN, Wall, **Wall Susan 11th** (8135).
3rd, No. 2575.—ALFRED W. WHITE, Hillegom, Spalding, **Spalding Mary 2nd** (7238).
4th, No. 2555.—ERNEST A. CROOKES, Rosene House Farm, Cutthorpe, Chesterfield, **Cutthorpe Surprise 29th** (5600).
5th, No. 2562.—G. H. JOHNSTONE, Trewithen, Grampound Road, Cornwall, **Trewithen Marigold** (247).
R.N. No. 2551.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Blackberry 82nd** (S. 1207).
H.C. No. 2558. C. No. 2563.

Class 355.—*Large White Sow, born in* 1938.

1st, No. 2610.—ALFRED W. WHITE, Hillegom, Spalding, **Spalding Queen 39th** (8028).
2nd, No. 2609.—ALFRED W. WHITE, Hillegom, Spalding, **Spalding Queen 38th** (8025).
3rd, No. 2589.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, **Walton Primrose 144th** (6958).
4th, No. 2602.—JAMES RUDDIN, St. John's Market, Liverpool, **Aintree Molly** (352).
5th, No. 2593.—W. DENNIS & SONS, LTD., Kirton, Boston, **Obo Belle 7th** (396).
R.N. No. 2608.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Wroot Maid 4th** (1541).
H.C. No. 2611. C. No. 2587.

Middle Whites.

No. 2628.—N.P.B.A. Champion Gold Medal for the best Boar and R.N. for Challenge Cup for the best Pig to CHIVERS & SONS' **Histon Choice Gentleman.**
No. 2622.—R.N. for Champion Gold Medal to THE WATFORD CORPORATION'S **Lancefield Goldfinder.**
No. 2648.—Champion Gold Medal for best Sow and Silver Challenge Cup for the best Pig to R. A. VESTEY'S **Dunsdale Princess 2nd.**
No. 2640.—R.N. for Champion Gold Medal to FRANK SAINSBURY'S **Wratting Garland 3rd.**

N.P.B.A. Special Prizes for best groups of Middle White Pigs bred by Exhibitor :—

1st, Gold Medal. Nos. 2626, 2648, 2656, 2661 to R. A. VESTEY'S **Dunsdale Prince 2nd, Dunsdale Princess 2nd, Dunsdale Princess 4th and Dunsdale Princess 5th.**
2nd, Silver Gilt Medal. Nos. 2627, 2642, 2650, 2663. to THE WATFORD CORPORATION'S **Watford Preceptor, Watford Gracious Lady, Watford Gracious Lady 52nd and Watford Gracious Lady 55th.**
R.N. Nos. 2616, 2625, 2640, 2647 to FRANK SAINSBURY'S **Wratting Sultan's Lad 12th, Wratting Prince, Wratting Garland 3rd and Wratting Miss Dorothy 7th.**

Class 356.—*Middle White Boar, born in or before* 1936.

1st, No. 2612.—CHIVERS & SONS, LTD., Histon, Cambridge, **Watford Alderman** 97623 (232).
2nd, No. 2615.—LESLIE K. OSMOND, Barnoldby-le-Beck, Grimsby, **Dunsdale Cocktai** 102547 (828).
3rd, No. 2616.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Sultan's Lad 12th** (W. 284).
R.N. No. 2617.—WATFORD CORPORATION, Holywell Farm, Watford, **Northcote Preceptor** 97595 (750).

Class 357.—*Middle White Boar, born in* 1937, *before July 1st.*

1st, No. 2622.—WATFORD CORPORATION, Holywell Farm, Watford, **Lancefield Goldfinder** 102597 (1370).
2nd, No. 2618.—T. A. W. BLACKWELL, Oxhey Place, Watford, **Oxhey Baronet** 102643 (3).
3rd, No. 2620.—CAPT. R. SPEED, Patmans, Coolham, Sussex, **Fearnside Imperial 2nd** (402).

Class 358.—*Middle White Boar, born in* 1937, *on or after July* 1*st.**

1st, No. 2624.—LESLIE K. OSMOND, Barnoldby-le-Beck, Grimsby, **Beelsby Deliverance 13th** (1625).
2nd, No. 2626.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale Prince 2nd** (1144).
3rd, No. 2627.—WATFORD CORPORATION, Holywell Farm, Watford, **Watford Preceptor** (559).
R.N. No. 2625.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Prince** (W. 385).

Class 359.—*Middle White Boar, born in* 1938.

1st, No. 2628.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Choice Gentleman** (324).
2nd, No. 2631.—LESLIE K. OSMOND, Barnoldby-le-Beck, Grimsby, **Beelsby Prince** (1663).
3rd, No. 2632.—CAPT. R. SPEED, Patmans, Coolham, Sussex, **Fearnside Imperial 3rd** (504).
R.N. No. 2634.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale White Prince 2nd** (1214).
C. No. 2629.

Class 360.—*Middle White Breeding Sow, born in or before* 1936.

1st, No. 2640.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Garland 3rd** 241930 (996).
2nd, No. 2642.—WATFORD CORPORATION, Holywell Farm, Watford, **Watford Gracious Lady** 228370 (762).
3rd, No. 2637.—NEWTON HERDS, LTD., South Newington, Banbury, **Newton Medina 5th** 267310 (2633).
R.N. No. 2636.—CHIVERS & SONS, LTD., Histon, Cambridge, **Watford Gracious Lady 14th.** 254762 (242).
H.C. No. 2639. C. No. 2641.

Class 361.—*Middle White Sow, born in* 1937, *before July* 1*st.*

1st, No. 2648.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale Princess 2nd** 267080 (1061).
2nd, No. 2650.—WATFORD CORPORATION, Holywell Farm, Watford, **Watford Gracious Lady 52nd** (493).
3rd, No. 2647.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Miss Dorothy 7th** (W. 325).
4th, No. 2646.—LESLIE K. OSMOND, Barnoldby-le-Beck, Grimsby, **Beelsby Garland 8th** 266954 (1543).
R.N. No. 2645.—NEWTON HERDS, LTD., South Newington, Banbury, **Newton Fuchsia 22nd** (3293).
H.C. No. 2644. C. Nos. 2643, 2652.

Class 362.—*Middle White Sow, born in* 1937, *on or after July* 1*st.*

1st, No. 2656.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale Princess 4th** (1152).
2nd, No. 2653.—T. A. W. BLACKWELL, Oxhey Place, Watford, **Oxhey Grace** (19).
3rd, No. 2654.—LESLIE K. OSMOND, Barnoldby-le-Beck, Grimsby, **Beelsby Fuchsia 13th** (1614).
R.N. No. 2657.—WATFORD CORPORATION, Holywell Farm, Watford, **Watford Gracious Lady 54th** (544).

Class 363.—*Middle White Sow, born in* 1938.

1st, No. 2662.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale Princess 6th** (1222).
2nd, No. 2661.—R. A. VESTEY, Valence, **Dunsdale Princess 5th** (1220).
3rd, No. 2658.—LESLIE K. OSMOND, Barnoldby-le-Beck, Grimsby, **Beelsby Princess 3rd** (1665).
R.N. No. 2663.—WATFORD CORPORATION, Holywell Farm, Watford, **Watford Gracious Lady 55th** (606).

Tamworths.

No. 2666.—Champion Silver Gilt Medal for the best Boar and Challenge Cup for the best Pig to T. R. WILSON'S **Rufforth Red Knight.**
No. 2664.—R.N. for Champion Silver Gilt Medal to MRS. CARLETON COWPER'S **Kentmere John Peel.**
No. 2676.—Champion Silver Gilt Medal for best Sow and R.N. for the Challenge Cup for best Pig to MRS. CARLETON COWPER'S **Eamont Laburnum.**
No. 2680.—R.N. for Champion Silver Gilt Medal to T. R. WILSON'S **Rufforth Annabella.**

Class 364.—*Tamworth Boar, born in or before* 1936.

1st, No. 2666.—T. R. WILSON, Victoria House, Rufforth, Yorks., **Rufforth Red Knight** 102751 (383).
2nd, No. 2664.—MRS. CARLETON COWPER, Eamont, Penrith, **Kentmere John Peel** 102737 (8).
3rd, No. 2665.—MRS. M. C. INGE, Thorpe Hall, Tamworth, **Wall Ducat** 92041 (199).

* Prizes offered by the National Pig Breeders' Association.

Class 365.—*Tamworth Boar, born in* 1937.*

1st, No. 2667.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Officer 102713** (79).
2nd, No. 2671.—T. R. WILSON, Victoria House, Rufforth, Yorks., **Wall Victor 2nd 102759** (260).
3rd, No. 2668.—ROWLAND P. HAYNES, Delves Green Farm, Walsall, **Berkswell Up-to-Date 30th 102699** (1122).
R.N. No. 2670.—MRS. M. C. INGE, Thorpe Hall, Tamworth, **Inge Vermilion 102725** (89).

Class 366.—*Tamworth Boar, born in* 1938.

1st, No. 2673.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Rajah** (127).
2nd, No. 2674.—MRS. M. C. INGE, Thorpe Hall, Tamworth, **Inge Starlight** (217).
3rd, No. 2672.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Royal Highness** (128).
R.N. No. 2675.—T. R. WILSON, Victoria House, Rufforth, Yorks., **Rufforth Stylish Lad** (545).

Class 367.—*Tamworth Breeding Sow, born in or before* 1936.

1st, No. 2676.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Laburnum 254928** (67).
2nd, No. 2680.—T. R. WILSON, Victoria House, Rufforth, Yorks., **Rufforth Annabella** (392).
3rd, No. 2678.—MRS. M. C. INGE, Thorpe Hall, Tamworth, **Inge Velvet 7th 254968** (142).
R.N. No. 2677.—CHARLES L. COXON, Milton, Pembridge, Leominster, **Milton Gloriana 32nd 267724** (553).

Class 368.—*Tamworth Sow, born in* 1937.

1st, No. 2688.—T. R. WILSON, Victoria House, Rufforth, Yorks., **Rufforth Matron 2nd** (434).
2nd, No. 2686.—MRS. M. C. INGE, Thorpe Hall, Tamworth, **Inge Vi 267710** (66).
3rd, No. 2681.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Rose 2nd 267672** (95).
R.N. No. 2682.—MRS. CARLETON COWPER, Eamont, **Eamont Prosperous Rose 267666** (106).

Class 369.—*Tamworth Sow, born in* 1938.

1st, No. 2689.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Shelagh** (132).
2nd, No. 2692.—NAPSBURY HOSPITAL, Napsbury Farm, St. Albans, **Burnham Miss Atlantic** (608).
3rd, No. 2691.—MRS. M. C. INGE, Thorpe Hall, Tamworth, **Inge Stella** (218).
R.N. No. 2690.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Ruth** (130).

Berkshires.

No. 2695.—N.P.B.A. Champion Silver Gilt Medal for the best Boar and Silver Challenge Bowl for the best Pig to FRANK TOWNEND'S **Chapel Keystone.**
No. 2694.—R.N. for Champion Silver Gilt Medal and R.N. for Silver Challenge Bowl to S. CECIL ARMITAGE'S **Burnham Prim Monarch.**
No. 2718.—N.P.B.A. Champion Silver Gilt Medal for the best Sow to FRANK TOWNEND'S **Highfield Princess Royal 76th.**
No. 2734.—R.N. for Champion Silver Gilt Medal to S. D. PLAYER'S **Whipling Amazon.**

Class 370.—*Berkshire Boar, born in or before* 1936.

1st, No. 2695.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds, **Chapel Keystone 4129** (30).
2nd, No. 2694.—S. CECIL ARMITAGE, Lenton Fields, Nottingham, **Burnham Prim Monarch 4271** (41).

Class 371.—*Berkshire Boar, born in* 1937, *before July* 1*st*.

1st, No. 2698.—S. D. PLAYER, Poulton Fields, Fairford, **Burnham Griqua Jubilee 4263** (119).
2nd, No. 2699.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds, **Highfield Royal Resolute 9th 4301** (104).
3rd, No. 2697.—FRED W. GENTLE, Avenue House, London Road, Brandon, **Brandon Lad 3rd** (3).
R.N. No. 2696.—LT.-COL. J. A. DUNNINGTON-JEFFERSON, D.S.O., Thicket Priory, York, **Thicket Royalist 4329** (954).

Class 372.—*Berkshire Boar, born in* 1937, *on or after July* 1*st*.*

1st, No. 2706.—S. D. PLAYER, Poulton Fields, Fairford, **Whipling Keeper** (54).
2nd, No. 2705.—FRED W. GENTLE, Avenue House, London Road, Brandon, **Burnham Griqua Princekin** (148).
3rd, No. 2701.—The HON. MRS. C. BEHRENS, Swinton Grange, Malton, Yorks., **Swinton Warrior 2nd** (50).
R.N. No. 2700.—THE HON. MRS. C. BEHRENS, Swinton Grange, **Burnham Griqua Princeling** (147).
H.C. Nos. 2703, 2704.

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*Prizes offered by the National Pig Breeders' Association.

Class 373.—*Berkshire Boar, born in* 1938.

1st, No. 2710.—S. D. PLAYER, Poulton Fields, Fairford, **Whipling Keith** (75).
2nd, No. 2708.—LT.-COL. J. A. DUNNINGTON-JEFFERSON, D.S.O., Thicket Priory, York, **Thicket Keystone 3rd** (38).
3rd, No. 2712.—COL. G. E. WILKINSON, C.B.E., D.S.O., Dringhouses Manor, York, **Dringhouses Commander** (163).
R.N. No. 2709.—FRED W. GENTLE, Avenue House, London Road, Brandon, **Brandon President** (47).
H.C. No. 2711.

Class 374.—*Berkshire Breeding Sow, born in or before* 1936.

1st, No. 2718.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds, **Highfield Princess Royal 76th** 14332 (81).
2nd, No. 2715.—FRED W. GENTLE, Avenue House, London Road, Brandon, **Burnham Griqua Maiden** 14858 (55).
3rd, No. 2717.—S. D. PLAYER, Poulton Fields, Fairford, **Burnham Griqua Noravina** 14554 (761).
R.N. No. 2716.—FRED W. GENTLE, Avenue House, London Road, Brandon, **Highbury Ruja Girl 2nd** 14956 (3).
H.C. Nos. 2713, 2714.

Class 375.—*Berkshire Sow, born in* 1937, *before July* 1*st.*

1st, No. 2722.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds, **Burnham Prim Princess** (111).
2nd, No. 2723.—FRANK TOWNEND, Highfield, **Warkton Musical Pet 3rd** (28).
3rd, No. 2719.—LT.-COL. J. A. DUNNINGTON-JEFFERSON, D.S.O., Thicket Priory, York, **Thicket Regina Lunn** 15040 (952).
R.N. No. 2724.—COL. G. E. WILKINSON, C.B.E., D.S.O., Dringhouses Manor, York, **Dringhouses Silene** 14944 (89).
H.C. No. 2721.

Class 376.—*Berkshire Sow, born in* 1937, *on or after July* 1*st.*

1st, No. 2730.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds, **Burnham Griqua Chieftainess** (149).
2nd, No. 2731.—COL. G. E. WILKINSON, C.B.E., D.S.O., Dringhouses Manor, York, **Dringhouses Marjorie** (107).
3rd, No. 2729.—S. D. PLAYER, Poulton Fields, Fairford, **Whipling Lady Keystone** (42).
R.N. No. 2727.—FRED W. GENTLE, Avenue House, London Road, Brandon, **Brandon Grand Duchess** (22).
H.C. No. 2728.

Class 377.—*Berkshire Sow, born in* 1938.

1st, No. 2734.—S. D. PLAYER, Poulton Fields, Fairford, **Whipling Amazon** (67).
2nd, No. 2735.—S. D. PLAYER, Poulton Fields, **Whipling Amber** (63).
3rd, No. 2736.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds, **Warkton Rosette** (4).
R.N. No. 2737.—COL. G. E. WILKINSON, C.B.E., D.S.O., Dringhouses Manor, York, **Dringhouses Barberry 4th** (157).
H.C. Nos. 2732, 2733.

Wessex Saddlebacks.

No. 2757.—N.P.B.A. Champion Silver Gilt Medal for the best Sow and R.N. for Challenge Cup to R. P. CHESTER'S **Roadwater Colleen 8th.**
No. 2772.—R.N. for Champion Silver Gilt Medal to W. R. JACKSON'S **Chancellors Viola.**
No. 2738.—N.P.B.A. Champion Silver Gilt Medal for the best Boar and Silver Challenge Cup for the best Pig to R. P. CHESTER'S **Brandon David 6th.**
No. 2740.—R.N. for Champion Silver Gilt Medal to W. R. JACKSON'S **Preston Sol 4th.**

N.P.B.A. Special Prizes for best groups of Wessex Saddleback Pigs, bred by Exhibitor:—
1st, £3. Nos. 2752, 2760, 2772, 2781 to W. R. JACKSON'S **Chancellors Sol, Chancellors Rosaleen, Chancellors Viola and Chancellors Elsis 8th.**

Class 378.—*Wessex Saddleback Boar, born in or before* 1936.

1st, No. 2738.—R. P. CHESTER, Warnford Farm, Wheely Down, Warnford, Southampton, **Brandon David 6th** 4208 (133).
2nd, No. 2740.—W. R. JACKSON, Chancellors Farm, Redhill, Bristol, **Preston Sol 4th** 4211 (20).
3rd, No. 2742.—C. P. WOOKEY, Manor House, Upavon, **Boreham Dandy** 3849 (157).

Class 379.—*Wessex Saddleback Boar, born in* 1937.*

1st, No. 2744.—R. P. CHESTER, Warnford Farm, Wheely Down, Warnford, Southampton, **Brandon David 12th** 4296 (223).
2nd, No. 2746.—M. B. U. DEWAR, Stagenhoe, Hitchin, **Preston Vagrant 3rd** 4374 (51).
3rd, No. 2745.—M. B. U. DEWAR, Stagenhoe, **Preston Vagrant 2nd** 4248 (52).

Class 380.—*Wessex Saddleback Boar, born in* 1938.

1st, No. 2750.—M. B. U. DEWAR, Stagenhoe, Hitchin, **Preston Chieftain 2nd** 4399 (5).
2nd, No. 2752.—W. R. JACKSON, Chancellors Farm, Redhill, Bristol, **Chancellors Sol** 4395 (10).

Class 381.—*Wessex Saddleback Breeding Sow, born in or before* 1936.

1st, No. 2757.—R. P. CHESTER, Warnford Farm, Wheely Down, Warnford, Southampton, **Roadwater Colleen 8th** 17875 (10).
2nd, No. 2755.—R. P. CHESTER, Warnford Farm, **Brandon Sunbeam 11th** 18227 (111).
3rd, No. 2756.—R. P. CHESTER, Warnford Farm, **Clough Lovely 11th** 18943 (44).
4th, No. 2759.—M. B. U. DEWAR, Stagenhoe, Hitchin, **Preston Vivienne 4th** 18899 (88).
R.N. No. 2760.—W. R. JACKSON, Chancellors Farm, Redhill, Bristol, **Chancellors Rosaleen** 18160 (29).

Class 382.—*Wessex Saddleback Sow, born in* 1937.

1st, No. 2772.—W. R. JACKSON, Chancellors Farm, Redhill, Bristol, **Chancellors Viola** 18924 (68).
2nd, No. 2767.—R. P. CHESTER, Warnford Farm, Wheely Down, Warnford, Southampton, **Brandon Daybeam 8th** 18921 (224).
3rd, No. 2775.—C. P. WOOKEY, Manor House, Upavon, **Boreham Dawn** 19680 (214).
4th, No. 2768.—M. B. U. DEWAR, Stagenhoe, Hitchin, **Preston Avid 5th** 19650 (A.41).
5th, No. 2769.—M. B. U. DEWAR, Stagenhoe, **Preston Shamrock 9th** 19651 (187).
R.N. No. 2774.—J. W. ROBERTS, Hill Farm, Shefford, Beds., **Shefford Venture 13th** 19718 (110).

Class 383.—*Wessex Saddleback Sow, born in* 1938.

1st, No. 2780.—M. B. U. DEWAR, Stagenhoe, Hitchin, **Preston Creation 7th** 19705 (A. 173).
2nd, No. 2781.—W. R. JACKSON, Chancellors Farm, Redhill, Bristol, **Chancellors Elsie 8th** 19697 (119).
3rd, No. 2782.—W. R. JACKSON, Chancellors Farm **Chancellors Ruby** 19698 (117).
R.N. No. 2779.—M. B. U. DEWAR, Stagenhoe, Hitchin, **Preston Creation 6th** 19704 (A. 171).

Large Blacks.

No. 2788.—Challenge Cup for best Boar to W. W. WOOLLAND'S **Pakenham Sundial 11th.**
No. 2786.—R.N. for Challenge Cup to DOUGLAS W. P. GOUGH'S **Pakenham Whizbang 1st.**
No. 2818.—Large Black Pig Society's Challenge Cup for the best Sow to DOUGLAS W. P. GOUGH'S **Pakenham Streamline.**
No. 2816.—R.N. for Challenge Cup to THE EARL OF DARTMOUTH'S **Patshull Ducat 38th.**
Nos. 2786, 2818, 2824.—"Baydon" Silver Challenge Cup for best group of Large Black Pigs to DOUGLAS W. P. GOUGH'S **Pakenham Whizbang 1st, Pakenham Streamline, Pakenham Delicacy 5th.**
Nos. 2788, 2821, 2831.—R.N. for "Baydon" Challenge Cup to W. W. WOOLLAND'S **Pakenham Sundial 11th, Baydon Silver Jubilee Nightingale 104th** and **Baydon Nightingale 111th.**

Class 384.—*Large Black Boar, born in or before* 1936.

1st, No. 2788.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., **Pakenham Sundial 11th** N. 165.
2nd, No. 2786.—DOUGLAS W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Whizbang 1st** P.179.
3rd, No. 2784.—F. G. ALEXANDER, Laurel's Farm, Pulham Market, Diss, Norfolk, **Depwade Duke** N.31.
R.N. No. 2785.—THE EARL OF DARTMOUTH, Patshull House, Wolverhampton, **Patshull Nigger** P.205.

Class 385.—*Large Black Boar, born in* 1937, *before July* 1*st.*

1st, No. 2792.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., **Baydon King George 2nd,** R.195.
2nd, No. 2791.—W. W. WOOLLAND, Baydon Manor, **Baydon King George** R.71.
3rd, No. 2790.—N. POMEROY & SON, East Stoke Farm, Stoke-under-Ham, Somerset, **Stokehamdon Sundial 9th** R.11.
R.N. No. 2789.—DOUGLAS W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Whizbang 9th** R.247.

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* Prizes offered by the National Pig Breeders' Association.

Class 386.—*Large Black Boar, born in* 1937, *on or after July* 1*st*.*

1st, No. 2802.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., **Baydon Sundial 2nd** R.271.
2nd, No. 2798.—SIR EDWARD MANN, BT., Thelveton Hall, Diss, Norfolk, **Thelveton Hero 59th** R.227.
3rd, No. 2796.—DOUGLAS W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Whizbang 10th** R.249.
R.N. No. 2800.—N. POMEROY & SON, East Stoke Farm, Stoke-under-Ham, Somerset, **Stokehamdon Sundial 10th** R.273.

Class 387.—*Large Black Boar, born in* 1938.

1st, No. 2814.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., **Baydon Sundial 3rd** S.79.
2nd, No. 2809.—SIR EDWARD MANN, BT., Thelveton Hall, Diss, Norfolk, **Thelveton Sundial** S.51.
3rd, No. 2805.—DOUGLAS W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Battleship** S.37.
4th, No. 2803.—C. J. BURROWS, Songar Grange, Wootton Wawen, Birmingham, **Songar Black Eagle** S.33.
5th, No. 2806.—DOUGLAS W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Illumination** S.75.
R.N. No. 2810.—SIR EDWARD MANN, BT., Thelveton Hall, Diss, Norfolk, **Thelveton Sundial 2nd** S.65.
H.C. Nos. 2807, 2815.

Class 388.—*Large Black Breeding Sow, born in or before* 1936.

1st, No. 2818.—DOUGLAS W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Streamline** M.1058.
2nd, No. 2816.—THE EARL OF DARTMOUTH, Patshull House, Wolverhampton, **Patshull Ducat 38th** N.794.
3rd, No. 2821.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., **Baydon Silver Jubilee Nightingale 104th** N.826.
R.N. No. 2819.—N. POMEROY & SON, East Stoke Farm, Stoke-under-Ham, Somerset, **Stokehamdon Sunshine 5th** N.664.

Class 389.—*Large Black Sow, born in* 1937, *before July* 1*st*.

1st, No. 2825.—SIR EDWARD MANN, BT., Thelveton Hall, Diss, Norfolk, **Thelveton Constance 18th** R.840.
2nd, No. 2824.—DOUGLAS W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Delicacy 5th** R.974.
3rd, No. 2831.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., **Baydon Nightingale 111th** R. 198.
4th, No. 2830.—W. W. WOOLLAND, Baydon Manor, **Baydon Nightingale 110th** R.196.
R.N. No. 2822.—F. G. ALEXANDER, Laurel's Farm, Pulham Market, Diss, Norfolk, **Depwade Clematis 3rd** R.132.
H.C. No. 2829. C. No. 2827.

Class 390.—*Large Black Sow, born in* 1937, *on or after July* 1*st*.

1st, No. 2834.—DOUGLAS W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Sometime 1st** R.976.
2nd, No. 2837.—SIR EDWARD MANN, BT., Thelveton Hall, Diss, Norfolk, **Thelveton Warbler 34th** R.846.
3rd, No. 2839.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., **Baydon Nightingale 117th** R.1048.
R.N. No. 2836.—T. F. JAMES, Warren Farm, Culham, Abingdon, **Treluckey Progress 21st** R.518.
H.C. No. 2835.

Class 391.—*Large Black Sow, born in* 1938.

1st, No. 2843.—SIR EDWARD MANN, BT., Thelveton Hall, Diss, Norfolk, **Thelveton Constance 26th** S.142.
2nd, No. 2844.—SIR EDWARD MANN, BT., Thelveton Hall, **Thelveton Warbler 48th** S.146.
3rd, No. 2847.—CAPTAIN D. M. WILLS, Barley Wood, Wrington, Somerset, **Barleywood Lovely Senorita 21st** S.178.
4th, No. 2842.—DOUGLAS W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Streamline 15th** S.118.
R.N. No. 2848.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., **Baydon Nightingale 118th** S.186.

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* Prizes offered by the Large Black Pig Society.

Gloucestershire Old Spots.

No. 2850.—Silver Challenge Cup for best Boar to J. F. WRIGHT'S **Solihull Bonzo.**
No. 2855.—R.N. for Challenge Cup to J. F. WRIGHT'S **Solihull Bob 20th.**
No. 2863.—Perpetual Silver Challenge Cup for the best Sow and Perpetual Silver Challenge Cup for the best Pig to HENRY B. SHIELDS' **Solihull Bonetta 14th.**
No. 2866.—R.N. for Challenge Cup for best Pig and best Sow to SHERIFF & SONS' **Nashes Duchess 64th.**

Class 392.—*Gloucestershire Old Spots Boar, born in or before* 1936.

1st, No. 2850.—J. F. WRIGHT, Gospel Oak, Lapworth, Warwickshire, **Solihull Bonzo** 6064.
2nd, No. 2849.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duke 35th** 6041.

Class 393.—*Gloucestershire Old Spots Boar, born in* 1937.*

1st, No. 2855.—J. F. WRIGHT, Gospel Oak, Lapworth, Warwickshire, **Solihull Bob 20th** 6069.
2nd, No. 2853.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duke 39th** 6075.
3rd, No. 2854.—HENRY B. SHIELD, Alkington Farm, Berkeley, Glos., **Solihull Bob 17th** 6061.
R.N. No. 2852.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duke 38th** 6065.

Class 394.—*Gloucestershire Old Spots Boar, born in* 1938.

1st, No. 2859.—J. F. WRIGHT, Gospel Oak, Lapworth, Warwickshire, **Solihull Richard 3rd** 6071.
2nd, No. 2860.—J. F. WRIGHT, Gospel Oak, **Solihull Richard 4th** 6072.
3rd, No. 2858.—HENRY B. SHIELD, Alkington Farm, Berkeley, Glos., **Solihull Richard 2nd** 6070.
R.N. No. 2857.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duke 41st** 6077.

Class 395.—*Gloucestershire Old Spots Breeding Sow, born in or before* 1936.

1st, No. 2863.—HENRY B. SHIELD, Alkington Farm, Berkeley, Glos., **Solihull Bonetta 14th** Z.883.
2nd, No. 2861.—S. C. FLOOK, Tynings Farm, Codrington, Chipping Sodbury, **Tyning Cream 10th** Z.865.
3rd, No. 2862.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duchess 61st** Z.895.
R.N. No. 2864.—J. F. WRIGHT, Gospel Oak, Lapworth, Warwickshire, **Solihull Gertie 15th** Z.866.

Class 396.—*Gloucestershire Old Spots Sow, born in* 1937.

1st, No. 2866.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duchess 64th** Z.963.
2nd, No. 2867.—J. F. WRIGHT, Gospel Oak, Lapworth, Warwickshire, **Solihull Josephine 32nd** Z.948.
3rd, No. 2868.—J. F. WRIGHT, Gospel Oak, **Solihull Josie** Z.966.
R.N. No. 2865.—S. C. FLOOK, Tynings Farm, Codrington, Chipping Sodbury, **Tyning Cream 17th** Z.983.

Class 397.—*Gloucestershire Old Spots Sow, born in* 1938.

1st, No. 2870.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duchess 65th** Z.964.
2nd, No. 2869.—S. C. FLOOK, Tynings Farm, Codrington, Chipping Sodbury, **Tyning Cream 14th** Z.980.
3rd, No. 2872.—HENRY B. SHIELD, Alkington Farm, Berkeley, Glos., **Solihull Primrose 25th** Z.967.
R.N. No. 2871.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duchess 66th** Z.965.

Cumberlands.

No. 2875.—Cumberland Pig Breeders' Association's Silver Challenge Cup for best Pig to W. BAINBRIDGE & SONS' **Sunnycroft Archer.**
No. 2882.—R.N. for Challenge Cup to W. BAINBRIDGE & SONS' **Tottie.**

Class 398.—*Cumberland Boar, born in or before* 1937.

1st, No. 2875.—W. BAINBRIDGE & SONS, Brougham Home Farm, Eamont Bridge, Penrith, **Sunnycroft Archer** 9880 (B.V.G.Q.14).
2nd, No. 2877.—ISAAC GARDHOUSE, Aikton House, Wigton, **Lone Boy** (C.D.I.T.11).
3rd, No. 2876.—W. BAINBRIDGE & SONS, Brougham Home Farm, Eamont Bridge, Penrith, **Woodside Tony** 10149 (B.W.W.T.26).

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* Prizes offered by the Gloucestershire Old Spots Pig Society.

Class 399.—*Cumberland Boar, born in* 1938.

1st, No. 2879.—W. Bainbridge & Sons, Brougham Home Farm, Eamont Bridge, Penrith, **Woodside Uriah** (B.W.W.U.11).
2nd, No. 2880.—Isaac Gardhouse, Aikton House, Wigton, **Aikton House Express** (G.D.I.U.1).
3rd, No. 2878.—W. Bainbridge & Sons, Brougham Home Farm, Eamont Bridge, Penrith, **Woodside Unicorn** (B.W.W.U.1).

Class 400.—*Cumberland Sow, born in or before* 1937.

1st, No. 2882.—W. Bainbridge & Sons, Brougham Home Farm, Eamont Bridge, Penrith, **Tottie** 10172. (P.T.3).
2nd, No. 2881.—W. Bainbridge & Sons, Brougham Home Farm, **Tamar** 10171 (P.T.4).
3rd, No. 2883.—John Maughan, Clockeld, Great Asby, Appleby, **Tilly** 10197. (M.G.N.T.8).

Class 401.—*Cumberland Sow, born in* 1938.*

1st, No. 2886.—Isaac Gardhouse, Aikton House, Wigton, **Aikton House Pansy** (G.D.I.U.6).
2nd No. 2887.—Isaac Gardhouse, Aikton House, **Aikton House Pansy 2nd** (G.D.I.U.7).
3rd, No. 2885.—W. Bainbridge & Sons, Brougham Home Farm, Eamont Bridge, Penrith, **Woodside Unitas** (B.W.W.U.7).
R.N. No. 2884.—W. Bainbridge & Sons, Brougham Home Farm, **Woodside Una** (B.W.W.U.6).

Essex.

No. 2889.—Essex Pig Society's Champion Silver Medal for the best Boar to Harold H. Bowser's **Cressing Grand Duke 23rd.**
No. 2900.—R.N. for Champion Medal to A. Herbert Carter's **Tydd Grand Duke.**
No. 2927.—Essex Pig Society's Champion Silver Medal for the best Sow and Champion Silver Cup for the best Pig to Harold H. Bowser's **Magdalen Pride 75th.**
No. 2924.—R.N. for Champion Medal and R.N. for Champion Cup to Eric T. Bailey's **Roothing Female 37th.**
Nos. 2889, 2925, 2927.—The "Sedgemere" Challenge Cup for the best group of Essex Pigs to Harold H. Bowser's **Cressing Grand Duke 23rd, Magdalen Pride 47th** and **Magdalen Pride 75th.**
Nos. 2900, 2940, 2955.—R.N. for Challenge Cup to A. Herbert Carter's **Tydd Grand Duke, Tydd Duchess 22nd** and **Tydd Female 6th.**

Class 402.—*Essex Boar, born in or before* 1936.

1st, No. 2889.—Harold H. Bowser, Swineshead House, Boston, Lincs., **Cressing Grand Duke 23rd** 4199.
2nd, No. 2892.—W. Ritchie, Marks Hall, Margaret Roding, Dunmow, **Cressing Grand Duke 35th** 4795.
3rd, No. 2888.—H. S. Ashton, Trueloves, Ingatestone, Essex, **Trueloves Orlop** 4615.
R.N. No. 2891.—G. E. Gittus, Barrow, Suffolk, **Saxham Kong** 4771.

Class 403.—*Essex Boar, born in* 1937, *before July* 1*st.*

1st, No. 2897.—W. Francis Foden, Whitemoor Haye, Fradley, Lichfield, **Magdalen Hero 23rd** 5209.
2nd, No. 2898.—G. E. Gittus, Barrow, Suffolk, **Saxham Kong 2nd** 5585.
3rd, No. 2893.—H. S. Ashton, Trueloves, Ingatestone, Essex, **Trueloves Duke** 5399.
R.N. No. 2896.—Cavaghan & Gray, Ltd., Harraby, Carlisle, **Greenwood Carlos** 5257.

Class 404.—*Essex Boar, born in* 1937, *on or after July* 1*st.*

1st, No. 2900.—A. Herbert Carter, Tydd Manor, Wisbech, **Tydd Grand Duke** 5553.
2nd, No. 2905.—Mrs. Frank Hilder, Huskards, Ingatestone, Essex, **Huskards Joey** 5413.
3rd, No. 2906.—W. Ritchie, Marks Hall, Margaret Roding, Dunmow, **Ashfields Dictator** 5635.
R.N. No. 2904.—G. E. Gittus, Barrow, Suffolk, **Saxham John** 5583.
H.C. No. 2903. **C.** No. 2902.

Class 405.—*Essex Boar, born in* 1938.

1st, No. 2911.—Harold H. Bowser, Swinshead House, Boston, Lincs., **Madgalen Hero 34th** 5615.
2nd, No. 2909.—Eric T. Bailey, Boggis, Roxwell, Chelmsford, **Roxwell Baron** 5599.
3rd, No. 2921.—Smith's Potato Estates, Ltd., Estate Office, Nocton, Lincoln, **Nocton Prince** 5649.
4th, No. 2922.—Wyndham T. Vint, Thorn Cottage, Wroot, Doncaster, **Hatfield Hero 3rd** 5545.
5th, No. 2919.—W. Ritchie, Marks Hall, Margaret Roding, Dunmow, **Roothing Grand Duke 11th** 5637.
R.N. No. 2912.—A. Herbert Carter, Tydd Manor, Wisbech, **Tydd Gay Lad 2nd** 5557.
H.C. Nos. 2917, 2918. **C.** 2910, 2915.

*** Prizes offered by the Cumberland Pig Breeders' Association.**

Class 406.—*Essex Breeding Sow, born in or before* 1936.

1st, No. 2927.—HAROLD H. BOWSER, Swineshead House, Boston, Lincs., **Magdalen Pride 75th** 28280.
2nd, No. 2924.—ERIC T. BAILEY, Boggis, Roxwell, Chelmsford, **Roothing Female 37th** 25954.
3rd, No. 2925.—HAROLD H. BOWSER, Swineshead House, Boston, Lincs., **Magdalen Pride 47th** 26166.
4th, No. 2930.—A. HERBERT CARTER, Tydd Manor, Wisbech, **Trueloves Nina** 23518.
R.N. No. 2932.—MRS. FRANK HILDER, Huskards, Ingatestone, Essex, **Walden Contract** 25022.
H.C. Nos. 2928, 2933. C. Nos. 2929, 2931.

Class 407.—*Essex Sow, born in* 1937, *before July 1st.*

1st, No. 2940.—A. HERBERT CARTER, Tydd Manor, Wisbech, **Tydd Duchess 22nd** 30232.
2nd, No. 2945.—W. FRANCIS FODEN, Whitemoor Haye, Fradley, Lichfield, **Booth Gamma 6th** 30972.
3rd, No. 2944.—W. FRANCIS FODEN, Whitemoor Haye, **Booth Gamma 5th** 30970.
4th, No. 2935.—H. S. ASHTON, Trueloves, Ingatestone, Essex, **Trueloves Primrose 7th** 30094.
5th, No. 2938.—A. HERBERT CARTER, Tydd Manor, Wisbech, **Tydd Duchess 10th** 28208.
R.N. No. 2943.—CAVAGHAN & GRAY, LTD., Harraby, Carlisle, **Greenwood Pride 8th** 28800.
H.C. Nos. 2934, 2941. C. Nos. 2942, 2946.

Class 408.—*Essex Sow, born in* 1937, *on or after July 1st.**

1st, No. 2955.—A. HERBERT CARTER, Tydd Manor, Wisbech, **Tydd Female 6th** 30848.
2nd, No. 2953.—A. HERBERT CARTER, Tydd Manor, **Tydd Duchess 24th** 30842.
3rd, No. 2958.—MRS. FRANK HILDER, Huskards, Ingatestone, Essex, **Huskards Treasure** 29926.
4th, No. 2951.—HAROLD H. BOWSER, Swineshead House, Boston, Lincs., **Magdalen Pride 125th** 30974.
5th, No. 2952.—HAROLD H. BOWSER, Swineshead House, **Magdalen Pride 126th** 30976.
R.N. No. 2956.—CAVAGHAN & GRAY, LTD., Harraby, Carlisle, **Greenwood Pride 17th** 31122.
H.C. No. 2959. C. Nos. 2949, 2957.

Class 409.—*Essex Sow, born in* 1938.

1st, No. 2971.—W. FRANCIS FODEN, Whitemoor Haye, Fradley, Lichfield, **Booth Lamlda** 31190.
2nd, No. 2968.—A. HERBERT CARTER, Tydd Manor, Wisbech, **Tydd Valentine 3rd** 30854.
3rd, No. 2979.—W. RITCHIE, Marks Hall, Margaret Roding, Dunmow, **Roothing Adelaide 5th** 31096.
4th, No. 2975.—MRS. FRANK HILDER, Huskards, Ingatestone, Essex, **Huskards Contract 3rd** 30774.
5th, No. 2981.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Hatfield Alfreda 7th** 30810.
R.N. No. 2964.—ERIC T. BAILEY, Boggis, Roxwell, Chelmsford, **Roxwell Queen 8th** 31034.
H.C. Nos. 2970, 2980. C. Nos. 2965, 2976.

Long White Lop-Eared.

No. 2982.—National Long White Lop-Eared Pig Society's Champion Silver Medal for the best Boar and the "Bezurrell" Challenge Cup for the best Pig to G. H. EUSTICE'S **Bezurrel Ben.**
No. 2992.—R.N. for Champion Medal to W. H. NEAL'S **Yealmpstone Jim 3rd.**
No. 2996.—National Long White Lop-Eared Pig Society's Champion Silver Medal for the best Sow and R.N. for "Bezurrell" Challenge Cup to W. H. NEAL'S **Yealmpstone Dainty 9th.**
No. 2998.—R.N. for Champion Medal to G. H. EUSTICE'S **Bezurrel Mary 58th.**

Class 410.—*Long White Lop-Eared Boar, born in or before* 1937.

1st, No. 2982.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, **Bezurrel Ben** 2832.
2nd, No. 2985.—W. H. NEAL, Walreddon Farm, Tavistock, **Yealmpstone Gay Boy 19th** 2988.
3rd, No. 2986.—W. J. WESTLAKE, Godwell, Ivybridge, Devon, **Godwell Admiral** 2568.
R.N. No. 2983.—H. R. JASPER, East Petherwin Farm, South Petherwin, Launceston, **Devonshire A.B.C.** 3018.

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* 1st, 2nd and 3rd Prizes offered by the Essex Pig Society.

Class 411.—*Long White Lop-Eared Boar, born in* 1938.

1st, No. 2992.—W. H. NEAL, Walreddon Farm, Tavistock, **Yealmpstone Jim 3rd** 3060.
2nd, No. 2987.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, **Bezurrel Ben 17th** 3052.
3rd, No. 2993.—W. J. WESTLAKE, Godwell, Ivybridge, Devon, **Godwell Nipper** 3066.
R.N. No. 2988.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, **Bezurrel Ben 18th** 3054.

Class 412.—*Long White Lop-Eared Breeding Sow, born in or before* 1936.

1st, No. 2996.—W. H. NEAL, Walreddon Farm, Tavistock, **Yealmpstone Dainty 9th** 8023.
2nd, No. 2997.—W. J. WESTLAKE, Godwell, Ivybridge, Devon, **Godwell Duchess 8th** 8071.
3rd, No. 2994.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, **Bezurrel Ruby 11th** 8017.
R.N. No. 2995.—H. R. JASPER, East Petherwin Farm, South Petherwin, Launceston, **Petherwin No. 1 of 1936** 8263.

Class 413.—*Long White Lop-Eared Sow, born in* 1937.

1st, No. 2998.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, **Bezurrel Mary 58th** 8377.
2nd, No. 3000.—W. H. NEAL, Walreddon Farm, Tavistock, **Yealmpstone No. 1 of 1937** 8439.
3rd, No. 2999.—H. R. JASPER, East Petherwin Farm, South Petherwin, Launceston, **Petherwin No. 1 of 1937** 8381.
R.N. No. 3001.—W. J. WESTLAKE, Godwell, Ivybridge, Devon, **Godwell Duchess 13th** 8369.

Class 414.—*Long White Lop-Eared Sow, born in* 1938.

1st, No. 3002.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, **Bezurrel Mona 43rd** 8481.
2nd, No. 3003.—G. H. EUSTICE, Bezurrel, **Bezurrel Mona 44th** 8483.
3rd, No. 3005.—H. R. JASPER, East Petherwin Farm, South Petherwin, Launceston **Petherwin No. 2 of 1938** 8507.
R.N. No. 3004.—H. R. JASPER, East Petherwin Farm, **Petherwin No. 1 of 1938** 8505.

Welsh.

No. 3010.—Welsh Pig Society's Champion Silver Medal for the best Boar to WYNDHAM T. VINT'S **Emlyn Gay Boy 3rd.**
No. 3011.—R.N. for Champion Medal to R. EWART OWEN'S **Prestatyn Turk 6th.**
No. 3022.—Welsh Pig Society's Champion Silver Medal for the best Sow to R. EWART OWEN'S **Prestatyn Dilys 1st.**
No. 3016.—R.N. for Champion Medal to R. EWART OWEN'S **Prestatyn Ida 1st.**

Class 415.—*Welsh Boar, born in or before* 1937.

1st, No. 3010.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Emlyn Gay Boy 3rd** 424 (V.T.336).
2nd, No. 3009.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn, **Prestatyn Turk 5th** 437 (D.U.521).

Class 416.—*Welsh Boar, born in* 1938.

1st, No. 3011.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn, **Prestatyn Turk 6th** 438 (D.U.603).
2nd, No. 3012.—R. EWART OWEN, Tanlan Hall Home Farm, **Prestatyn Turk 7th** 439 (D.U.605).
3rd, No. 3013.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Emlyn Gay Boy 5th** 436 (V.T.432).

Class 417.—*Welsh Sow, born in or before* 1936, *in farrow or having farrowed.*

1st, No. 3016.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn, **Prestatyn Ida 1st** 907 (D.U.144).
2nd, No. 3017.—R. EWART OWEN, Tanlan Hall Home Farm, **Prestatyn Lucy 32nd** 995 (D.U.190).
3rd, No. 3018.—DAVID THOMAS, Lydmoor Farm, St. Nicholas, Cardiff, **Lydmoor Megan 4th** 1094 (D.T.21).
R.N. No. 3019.—DAVID THOMAS, Lydmoor Farm, **Silurian Diana 1st** 517 (G.W.44).

Class 418.—*Welsh Sow, born in* 1937. *in farrow or having farrowed.**

1st, No. 3022.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn, **Prestatyn Dilys 1st** 1047 (D.U.357).
2nd, No. 3025.—THOMAS M. WILLIAMS, Brechfa, Clynderwen, Pembs., **Derwen Queen 4th** 1053 (J.T.71).
3rd, No. 3023.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Emlyn Betty** 1038 (V.T.294).
R.N. No. 3024.—WYNDHAM T. VINT, Thorn Cottage, **Emlyn Lucy 9th** 1112 (V.T.308).

* Prizes offered by the Welsh Pig Society.

Class 419.—*Pair of Welsh Sows, in farrow or having farrowed.*

1st, Nos. 3018-3019, DAVID THOMAS, Lydmoor Farm, St. Nicholas, Cardiff, **Lydmoor Megan 4th** 1094 (D.T.21), **Silurian Diana 1st** 517 (G.W.44).
2nd, Nos. 3016-3017.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn, **Prestatyn Ida 1st** 907 (D.U.144), **Prestatyn Lucy 32nd** 995 (D.U.190).
3rd, Nos. 3020-3023.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Emlyn Fairy 4th** 926 (D.T.217), **Emlyn Betty** 1038 (D.T. 294).
R.N. Nos. 3025-3026.—THOMAS M. WILLIAMS, Brechfa, Clynderwen, Pembs., **Derwen Queen 4th** 1053 (J.T.71), **Derwen Queen 5th** 1054 (J.T. 72).

Class 420.—*Welsh Sow, born in* 1938.

1st, No. 3030.—THOMAS M. WILLIAMS, Brechfa, Clynderwen, Pembs., **Brechfa Mona** 1118 (T.W.133).
2nd, No. 3028.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Emlyn Fairy 5th** 1116 (V.T.433).
3rd, No. 3029.—WYNDHAM T. VINT, Thorn Cottage, **Emlyn Impartial 2nd** 113 (V.T.413).
R.N. No. 3027.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn, **Prestatyn Dilys 4th** 1120 (D.U.608).

Class 421.—*Pair of Welsh Sows, born in* 1938.

1st, Nos. 3027-3031.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn, **Prestatyn Dilys 4th** 1120 (D.U.608), **Prestatyn Dilys 5th** 1121 (D.U.609).
2nd, Nos. 3029-3033.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Emlyn Impartial 2nd** 1113 (V.T.413), **Emlyn Impartial 3rd** 1114 (V.T.414).
3rd, Nos. 3028-3032.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Emlyn Fairy 5th** 1116 (V.T.433), **Emlyn Fairy 6th** 1117 (V.T.450).

POULTRY.

By "Cock" and "Hen" are meant birds hatched previous to November 1, 1937; and by "Cockerel" and "Pullet" are meant birds hatched on or after November 1, 1937.

The Prizes are as follows: **First Prize 30s.; Second Prize, 20s.; Third Prize, 10s.; Fourth Prize, 5s.**

"P.F." stands for "Poultry Farm."

Classes omitted were cancelled owing to insufficient entries.

Class 422.—*Dorking Cock or Cockerel.*

1st, No. 6, & 2nd, No. 2.—SAMUEL OATEY, Chacewater, Truro.
3rd, No. 4.—RALPH ALTY, Mill House, Croston, Preston.
4th, No. 1.—A. J. MAJOR, Ditton, Langley, Bucks.
R.N. No. 3.—V. A. BAYLEY, Massey Farm, Upper Millichope, Church Stretton.
H.C. No. 5.

Class 423.—*Dorking Hen or Pullet.*

1st, No. 12 & 4th, No. 10.—SAMUEL OATEY, Chacewater, Truro.
2nd, No. 9.—RALPH ALTY, Mill House, Croston, Preston.
3rd, No. 7 & R.N., No. 11.—A. J. MAJOR, Ditton, Langley, Bucks.
H.C. No. 8.

Class 424.—*Croad Langshan Cock or Cockerel.*

1st & Croad Langshan Club's Special, No. 14 & 3rd, No. 19.—C. F. BARKER, 51, Waverley, Brays Lane, Coventry.
2nd, & R.N. for Special, No. 13.—HAROLD CHURCH, Godshill, Fordingbridge, Hants.
4th, No. 15.—E. J. TAUNTON, Harnham Hollows, Salisbury.
R.N. No. 17.—EDWARD COCKER, 114, Towngate, Leyland. Lancs.
H.C. No. 18. C. No. 16.

Class 425.—*Croad Langshan Hen or Pullet.*

1st & Croad Langshan Club's Special, No. 24.—EDWARD COCKER, 114, Towngate, Leyland, Lancs.
2nd & R.N. for Special, No. 21 & 4th, No. 26.—E. J. TAUNTON, Harnham Hollows, Salisbury.
3rd, No. 22.—E. T. POULTNEY, Ivy Lodge, Cromhall, Charfield, Glos.
R.N. No. 23.—MISS G. M. MILBURN, The Bungalow, Rhoose, Glam.

Class 426.—*Light Sussex Cock.*

1st, No. 28.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.
2nd, No. 30.—W. BORTHWICK, The Old Rectory, Hatfield.
3rd, No. 29.—H. UNDERWOOD & SON, Mowshurst P.F., Edenbridge.

Class 427.—*Light Sussex Hen.*

1st & R.N. for Crawshay Cup, No. 35.—CAPT. E. DUCKWORTH, Merriewood Farm, Crawley Down.
2nd, No. 32.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.
3rd, No. 34.—W. BORTHWICK, The Old Rectory, Hatfield.
4th, No. 33.—H. UNDERWOOD & SON, Mowshurst P.F., Edenbridge.
R.N. No. 31.—COL. D. A. CHAYTOR, Pooley Hall, Polesworth, Tamworth.
H.C. No. 36.

Class 428.—*Sussex any other Colour Cock.*

1st, No. 37 & **3rd**, No. 40.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.
2nd, No. 39.—CAPT. E. DUCKWORTH, Merriewood Farm, Crawley Down.
4th, No. 38.—J. DUMBLETON, Sheen Croft, Didcot.

Class 429.—*Sussex any other Colour Hen.*

1st, No. 43.—CAPT. E. DUCKWORTH, Merriwood Farm, Crawley Down.
2nd, No. 42.—J. DUMBLETON, Sheen Croft, Didcot.
3rd, No. 44 & **4th**, No. 41.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.

Class 430.—*Light Sussex Cockerel.*

1st & Crawshay Memorial Cup, No. 46 & **2nd**, No. 51.—LORD KEMSLEY, Farnham P.F., Farnham Royal, Bucks.
3rd, No. 47.—H. UNDERWOOD & SON, Mowshurst P.F., Edenbridge.
4th, No. 45.—COL. D. A. CHAYTOR, Pooley Hall, Polesworth, Tamworth.
R.N. No. 50.—W. BORTHWICK, The Old Rectory, Hatfield.
H.C. No. 52. **C.** No. 49.

Class 431.—*Light Sussex Pullet.*

1st, No. 54 & **2nd**, No. 59.—LORD KEMSLEY, Farnham Royal P.F., Farnham Royal, Bucks.
3rd, No. 60.—W. BORTHWICK, The Old Rectory, Hatfield.
4th, No. 61 & **R.N.**, No. 55.—H. UNDERWOOD & SON, Mowshurst P.F., Edenbridge.
H.C. No. 56. **C.** No. 58.

Class 432.—*White Sussex Cockerel.*

1st, No. 65, **2nd**, No. 62 & **3rd**, No. 64.—CAPT. E. DUCKWORTH, Merriewood Farm, Crawley Down.

Class 434.—*Sussex any other Colour Cockerel.*

1st, No. 67 & **2nd**, No. 69.—LORD KEMSLEY, Farnham Royal P.F., Farnham Royal, Bucks.
3rd, No. 66.—W. J. GOLDING, Bowens, Penshurst, Kent.
4th, No. 68.—J. DUMBLETON, Sheen Croft, Didcot.

Class 435.—*Sussex any other Colour Pullet.*

1st, No. 70.—W. J. GOLDING, Bowens, Penshurst, Kent.
2nd, No. 71 & **3rd**, No. 73.—LORD KEMSLEY, Farnham Royal P.F., Farnham Royal, Bucks.
4th, No. 72.—J. DUMBLETON, Sheen Croft, Didcot.

Class 436.—*White Wyandotte Cock or Cockerel.*

1st, No. 81.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
2nd, No. 79.—ARTHUR SKINNER, New Lodge Cottage, Gorseinon, Glam.
3rd, No. 76.—D. B. CHESTERFIELD, Ivy Cottage, Pontmeathvaughan, Glam.
4th, No. 78.—MORRIS BROS., 2, Talybont, Bangor.
R.N. No. 77.—D. J. EDWARDS, 3, High Street, Narberth, Pemb.

Class 438.—*Wyandotte any other Colour Cock or Cockerel.*

1st, No. 84.—JAMES MELLOR, Tunstead Wormhill, Buxton.
2nd, No. 83.—COL. HUMPHREY WATTS, O.B.E., Haslington Hall, Haslington, Crewe.
3rd, No. 82.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
4th, No. 85.—J. G. MORTEN, Pentrich, Derby.

Class 439.—*Wyandotte any other Colour Hen or Pullet.*

1st, No. 89.—JOHN WHARTON, Honeycott Farm, Hawes, Yorks.
2nd, No. 88.—COL. HUMPHREY WATTS, O.B.E., Haslington Hall, Haslington, Crewe.
3rd, No. 87.—W. H. LEESON, 91, Harnall Lane East, Coventry.
4th, No. 86.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.

Class 440.—*Buff Orpington Cock or Cockerel.*

1st, & **Buff Orpington Club's Special,** No. 90, & **3rd,** No. 93.—W. J. GOLDING, Bowens, Penshurst, Kent.
2nd, & **R.N. for Special,** No. 92.—J. D. ORR, Dasherhead Smithy, Gargunnock, Stirling.
4th, No. 91.—GEORGE ROGERS, 51, Globe Road, Romford.

Class 441.—*Buff Orpington Hen or Pullet.*

1st, No. 95 & **4th,** No. 98.—W. J. GOLDING, Bowens, Penshurst, Kent.
2nd, No. 97.—J. D. ORR, Dasherhead Smithy, Gargunnock, Stirling.
3rd, No. 96.—GEORGE ROGERS, 51, Globe Road, Romford.

Class 442.—*Orpington any other Colour Cock or Cockerel.*

1st, No. 106, & **4th,** No. 102.—JOHN BURDETT, 1, Lake Bank Terrace, Wingate, co. Durham.
2nd, No. 107.—J. D. ORR, Dasherhead Smithy, Gargunnock, Stirling.
3rd, No. 101.—MORRIS BROS., 2, Talybont Bangor.
R.N. No. 99.—COL. HUMPHREY WATTS, O.B.E., Haslington Hall, Haslington, Crewe.
H.C. No. 103. **C.** No. 104.

Class 443.—*Orpington any other Colour Hen or Pullet.*

1st, No. 111, & **3rd,** No. 109.—JOHN BURDETT, 1, Lake Bank Terrace, Wingate, co. Durham.
2nd, No. 108, & **R.N.,** No. 112.—TOM TRIGG, The Oaks, Anthill, Denmead, Cosham.
4th, No. 110.—WILLIAM GRAY, Buller Mine, Redruth, Cornwall.

Class 444.—*Rhode Island Red Cock.*

1st, & **Rhode Island Red Club's Special,** No. 121, & **R.N.,** No. 124.—R. MOORE, The Orchards, Long Sutton, Lincs.
2nd, No. 117.—G. EXELBY, 97, Poppleton Road, York.
3rd, No. 113.—LORD GREENWAY, Stanbridge Earls P. F., Edenbridge.
4th, No. 122.—G. H. MUZZLEWHITE, Redlands, Tavistock.
H.C. No. 116. **C.** No. 118.

Class 445.—*Rhode Island Red Hen.*

1st, & **Rhode Island Red Club's Special,** No. 132, and **2nd,** No. 129.—R. MOORE, The Orchards, Long Sutton, Lincs.
3rd, No. 127.—OVALTINE POULTRY FARM, King's Langley, Herts.
4th, No. 126.—I. DAVIES, Sunny Bank, Godrer Graig, Ystalyfera, Glam.
R.N., No. 131.—J. H. BAKER & SON, Windyash, Barnstaple.
H.C. No. 130. **C.** No. 125.

Class 446.—*Rhode Island Red Cockerel.*

1st, & **R.N. for Special,** No. 133.—LORD GREENWAY, Stanbridge Earls P.F., Edenbridge.
2nd, No. 142.—J. H. NORMAN, Burrow, Wooton Courtenay, Minehead.
3rd, No. 136.—R. MOORE, The Orchards, Long Sutton, Lincs.
4th, No. 143.—DR. N. H. KETTLEWELL, Lodway Manor, Easton-in-Gordano, Bristol.
R.N. No. 137.—G. H. MUZZLEWHITE, Redlands, Tavistock.
H.C. No. 140. **C.** No. 139.

Class 447.—*Rhode Island Red Pullet.*

1st, & **R.N. for Special,** No. 151, & **3rd,** No. 148.—R. MOORE, The Orchards, Long Sutton, Lincs.
2nd, No. 147.—MORGAN MATTHEW, New House, Ystradowen, Cowbridge.
4th, No. 149.—G. H. MUZZLEWHITE, Redlands, Tavistock.
R.N. No. 144.—LORD GREENWAY, Stanbridge Earls P.F., Edenbridge.
H.C. No. 150. **C.** No. 146.

Class 448.—*Barred Plymouth Rock Cock or Cockerel.*

1st, & **Plymouth Rock Society's Special,** No. 160.—J. D. ORR, Dasherhead Smithy, Gargunnock, Stirling.
2nd, No. 161, & **R.N.,** No. 159.—PENPRASE BROS., Trevingey, Redruth.
3rd, No. 156.—WALTER BALDERSON, 55, Alexandra Avenue, Southall.
4th, No. 158.—W. BORTHWICK, The Old Rectory, Hatfield.
H.C. Nos. 152, 155.

Class 449.—*Barred Plymouth Rock Hen or Pullet.*

1st, & **R.N. for Special,** No. 166.—W. BORTHWICK, The Old Rectory, Hatfield.
2nd, No. 164.—J. FAWCETT, Field House, Austwick, Lancaster.
3rd, No. 162.—E. MARSHALL, 7, Gregory Street, Lenton, Nottingham.
4th, No. 167, & **R.N.,** No. 169.—PENPRASE BROS., Trevingey, Redruth.
H.C. No. 168.

Class 450.—*Buff Plymouth Rock Cock or Cockerel.*

1st, & **Plymouth Rock Society's Special,** & **Buff Plymouth Rock Club's Special,** No. 179.—H. T. STONEX, Burlands Farm, Taunton.
2nd, No. 172.—BILSBOROUGH & BLAND, Park Lane P.F., Forton, Preston.
3rd, No. 173.—W. BORTHWICK, The Old Rectory, Hatfield.
4th, No. 170.—THOMAS ATKINSON, Croft P.F., Burton-in-Lonsdale, Carnforth.
R.N. No. 176.—HOWARD PAGE, The Cedars, Great Horkesley, Colchester.
H.C. Nos. 174, 178, 180.

Class 451.—*Buff Plymouth Rock Hen or Pullet.*

1st, & **R.N. for Specials,** No. 182.—BILSBOROUGH & BLAND, Park Lane P.F., Forton, Preston.
2nd, No. 187.—J. D. ORR, Dasherhead Smithy, Gargunnock, Stirling.
3rd, No. 181.—THOMAS ATKINSON, Croft P.F., Burton-in-Lonsdale, Carnforth.
4th, No. 183.—W. BORTHWICK, The Old Rectory, Hatfield.
R.N. No. 186.—J. H. THORNTON, Hornby House, Cabus, Garstang, Preston.
H.C. Nos. 184, 185.

Class 452.—*Plymouth Rock or any other Colour Cock or Cockerel.*

1st, & **R.N. for Special,** No. 190.—W. BORTHWICK, The Old Rectory, Hatfield.
2nd, No. 189, & **3rd,** No. 192.—J. D. ORR, Dasherhead Smithy, Gargunnock, Stirling.
4th, No. 191.—CAPT. E. DUCKWORTH, Merriewood Farm, Crawley Down.

Class 453.—*Plymouth Rock any other Colour Hen or Pullet.*

1st, & **Plymouth Rock Society's Special,** No. 200, & **3rd,** No. 193.—J. D. ORR, Dasherhead Smithy, Gargunnock, Stirling.
2nd, No. 195.—W. BORTHWICK, The Old Rectory, Hatfield.
4th, No. 197.—E. W. ALLENBY, Three Oaks, Virginia Water.
R.N. No. 196.—CAPT. E. DUCKWORTH, Merriewood Farm, Crawley Down.

Class 454.—*Barnevelder Cock or Cockerel.*

1st, No. 205.—CAPT. E. DUCKWORTH, Merriewood Farm, Crawley Down.
2nd, No. 207.—TOM THOMAS, 67, New Road, Ammanford, Carm.
3rd, No. 203.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
4th, No. 202.—JOHN BURDETT, 1, Lake Bank Terrace, Wingate, co. Durham.
H.C. No. 206. **C.** No. 201.

Class 455.—*Barnevelder Hen or Pullet.*

1st, No. 210.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
2nd, No. 211.—CAPT. E. DUCKWORTH, Merriewood Farm, Crawley Down.
3rd, No. 209.—JOHN BURDETT, 1, Lake Bank Terrace, Wingate, co. Durham.
4th, No. 128.—J. E. H. & MISS VENNING, Trefrank, St. Clether, Launceston.
H.C. No. 212. **C.** No. 208.

Class 456.—*Faverolles Cock or Cockerel.*

1st, No. 213.—H. W. BIDDLECOMBE, Prestberries, Hartpury, Gloucester.
2nd, No. 221.—HARRY FOX, Richmond P.F., Matlock.
3rd, No. 218.—L. H. VOADEN & SON, Hagel Brow, Okehampton.
4th, No. 220.—MRS. H. A. CLIVE, The Hill House, Hartpury, Gloucester.
H.C. Nos. 215, 217, 219.

Class 457.—*Faverolles Hen or Pullet.*

1st, No. 226, & **2nd,** No. 224.—MRS. H. A. CLIVE, The Hill House, Hartpury, Gloucester.
3rd, No. 222, & **R.N.,** No. 227.—H. W. BIDDLECOMBE, Prestberries, Hartpury, Gloucester.
4th, No. 225.—L. H. VOADEN & SON, Hazel Brow, Okehampton.

Class 458.—*Australorp Cock or Cockerel.*

1st, No. 229.—T. B. CLARKSON, Bond's P.F., Pilling, Preston.
2nd, No. 231, & **3rd,** No. 228.—A. J. SPINK, Stud Farm, Weston, Newark.
4th, No. 230.—F. J. CHESHIRE, 22, Wharf Road, Grantham.

Class 459.—*Australorp Hen or Pullet.*

1st, No. 236.—CAPT. E. DUCKWORTH, Merriewood Farm, Crawley Down.
2nd, No. 232.—JOSEPH BLACKBURN, Craven Nursery, Thornton-in-Craven, Skipton.
3rd, No. 235.—J. W. SPARROW, Fir Tree Cottage, Great Bromley, Colchester.
4th, No. 223.—J. E. H. & MISS VENNING, Trefrank, St. Clether, Launceston.
R.N. No. 234.—T. B. CLARKSON, Bond's P.F., Pilling, Preston.
H.C. No. 233. **C.** No. 237.

Class 460.—*Indian Game Cock or Cockerel.*

1st, No. 241.—W. M. DAVIES, 32, New Road, Llandilo.
2nd, No. 242.—CECIL BRENT, Clampit, Callington, Cornwall.
3rd, No. 239.—E. A. JONAS, Hillstead, Church Street, Paignton.
4th, No. 240.—W. W. WHITEMAN, Abbots Lodge, Sandhurst, Gloucester.
R.N. No. 238.—C. CREE, Moignes Court, Ower Moigne, Dorchester.
H.C. No. 243.

Class 461.—*Indian Game Hen or Pullet.*

1st, No. 246.—CECIL BRENT, Clampit, Callington, Cornwall.
2nd, No. 247.—H. J. G. HAWKEY, Roserrow, St. Minver, Wadebridge, Cornwall.
3rd, No. 244.—E. A. JONAS, Hillstead, Church Street, Paignton.
4th, No. 245.—J. H. BAKER & SON, Windyash, Barnstaple.

Class 462.—*Jubilee Indian Game Cock or Cockerel.*

1st, & R.N. for Special, No. 250, 3rd, No. 251, 4th, No. 248.—W. W. WHITEMAN, Abbots Lodge, Sandhurst, Gloucester.
2nd, No. 249.—K. J. G. HAWKEY, Roserrow, St. Minver, Wadebridge, Cornwall.

Class 463.—*Jubilee Indian Game Hen or Pullet.*

1st, & Jubilee Indian Game Club's Special, No. 256, 3rd, No. 255, 4th, No. 253.—W. W. WHITEMAN, Abbots Lodge, Sandhurst, Gloucester.
2nd, No. 252.—W. M. DAVIES, 32, New Road, Llandilo.

Class 464.—*Old English Game Black- or Brown-Red Cock or Cockerel.*

1st, No. 257.—STAN BUTLER, 16, Blaencuppin Road, Llanhilleth, Mon.
2nd, No. 265.—GEORGE DREW, 3, Brecon Road, Hirwaun, Aberdare.
3rd, No. 270.—ROBERT KERR, Westcrag, Loop Road, Whitehaven.
4th, No. 261.—R. D. BLIGHT, Totnes.
R.N. No. 264.—JOSEPH JONES, 4, Cynon Row, Trecynon, Aberdare.
H.C. Nos. 259, 260, 271. C. No. 268.

Class 465.—*Old English Game Black- or Brown-Red Hen or Pullet.*

1st, No. 280, & 2nd, No. 283.—GEORGE DREW, 3, Brecon Road, Hirwaun, Aberdare.
3rd, No. 285.—J. MORGAN & SONS, Brynamlwg, Derwen Road, Ystradgynlais, Swansea.
4th, No. 279.—R. D. BLIGHT, Totnes.
R.N. No. 273.—JOSEPH JONES, 4, Cynon Row, Trecynon, Aberdare.
H.C. Nos. 272, 284.

Class 466.—*Old English Game any other Colour Cock or Cockerel.*

1st, No. 289.—R. D. BLIGHT, Totnes.
2nd, No. 295, & 3rd, No. 298.—R. B. PRICE, Briton, Rhayader.
4th, No. 290.—H. HOUGH WATSON, Braystones House, Beckermet.
R.N. No. 293.—E. P. HUGHES, Crumpwell, Oswestry.
H.C. Nos. 287, 292, 294, 296.

Class 467.—*Old English Game any other Colour Hen or Pullet.*

1st, No. 309.—R. B. PRICE, Briton, Rhayader.
2nd, No. 303.—CHARLES STARR, 20, Darran Terrace, Ferndale, Rhondda.
3rd, No. 311.—R. D. BLIGHT, Totnes.
4th, No. 308.—J. H. BAKER & SON, Windyash, Barnstaple.
R.N. No. 304.—H. HOUGH-WATSON, Braystones House, Beckermet.
H.C. Nos. 299, 300. C. No. 301.

Class 468.—*Minorca Cock or Cockerel.*

1st, No. 315.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
2nd, No. 313.—A. G. F. PITTS, Brick Works, Alvechurch, Birmingham.
3rd, No. 316, & 4th, No. 319.—W. MILLERSHIP, Avondale Road, Pontrhydyrun, Newport, Mon.
R.N. No. 314.

Class 469.—*Minorca Hen or Pullet.*

1st, No. 320.—COL. HUMPHREY WATTS, O.B.E., Haslington Hall, Haslington, Crewe.
2nd, No. 321, & 4th, No. 327.—FRANK NORMAN, 17, Devon Place, Grangetown, Cardiff.
3rd, No. 323.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
R.N. No. 326.—R. DAVEY, 54, West Street, Bridgwater, Somerset.
H.C. No. 325. C. No. 322.

Class 470.—*White Leghorn Cock or Cockerel.*

1st, No. 329.—W. BORTHWICK, The Old Rectory, Hatfield.
2nd, No. 328.—OVALTINE POULTRY FARM, King's Langley, Herts.

Class 471.—*White Leghorn Hen or Pullet.*

1st, No. 332.—W. HAMNETT, Myrtle P.F., Breck Road, Poulton-le-Fylde.
2nd, No. 335.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
3rd, No. 334.—H. SPENCER, Leghorn Yard, Melksham.
4th, No. 333.—OVALTINE POULTRY FARM, King's Langley, Herts.

Class 472.—*Leghorn any other Colour Cock or Cockerel.*

1st, No. 337, **3rd,** No. 345 & **R.N.,** No. 341.—R. MCPHERSON, Drumboy, Strathaven, Lanarkshire.
2nd, No. 336.—W. E. GILLING, Buckland, Frome.
4th, No. 338.—OVALTINE POULTRY FARM, King's Langley, Herts.
H.C. No. 340. **C.** No. 344.

Class 473.—*Leghorn any other Colour Hen or Pullet.*

1st, No. 346.—W. H. LEESON, 91, Harnall Lane East, Coventry.
2nd, No. 347.—COL. HUMPHREY WATTS, O.B.E., Haslington Hall, Haslington, Crewe.
3rd, No. 350.—GEORGE ROGERS, 51, Globe Road, Romford.
4th, No. 348.—OVALTINE POULTRY FARM, King's Langley, Herts.
R.N. No. 349.—S. W. HOPKINSON, Alton P.F., Alton, Old Tupton, Chesterfield.
H.C. No. 351.

Class 476.—*Ancona Cock or Cockerel.*

1st, No. 355.—E. A. STEPHENS, Place, Portscatho, Cornwall.
2nd, No. 357 & **3rd,** No. 354.—ANDREW SOUTHERIN, 88, Burnley Road, Padiham.
4th, No. 352.—W. HAMNETT, Myrtle P.F., Breck Road, Poulton-le-Fylde.
R.N. No. 353.—LEWIS & MORGANS, 51, Penrhys Road, Ystrad-Rhondda.
H.C. No. 356.

Class 477.—*Ancona Hen or Pullet.*

1st, No. 359 & **3rd,** No. 362.—ANDREW SOUTHERIN, 88, Burnley Road, Padiham.
2nd, No. 360.—E. A. STEPHENS, Place, Portscatho, Cornwall.
4th, No. 358.—W. HAMNETT, Myrtle P.F., Breck Road, Poulton-le-Fylde.
R.N. —No. 361.—J. H. BAKER & SON, Windyash, Barnstaple.

Class 478.—*Welsummer Cock or Cockerel.*

1st, No. 372 & **4th,** No. 369.—D. SHAKESHAFT, 25, The Circuit, Moor Lane, Wilmslow
2nd, No. 365.—F. A. COLES, Kilmersdon, Bath.
3rd, No. 370.—J. D. ORR, Dasherhead Smithy, Gargunnock, Stirling.
R.N. No. 366.—J. E. H. & MISS VENNING, Trefrank, St. Clether, Launceston.
H.C. No. 371.

Class 479.—*Welsummer Hen or Pullet.*

1st, No. 379.—E. W. ALLENBY, Three Oaks, Virginia Water.
2nd, No. 375.—C. A. THOMPSON, Home Farm, Cranford, Kettering.
3rd, No. 378.—D. SHAKESHAFT, 25, The Circuit, Moor Lane, Wilmslow.
4th, No. 376.—A. PICKARD, Bull Ring, Nuneaton.
R.N. No. 380.—J. D. ORR, Dasherhead Smithy, Gargunnock, Stirling.
H.C. No. 377.

Class 480.—*Any other Distinct Variety Heavy Cock or Cockerel.*

1st., No. 384.—J. Sivel, Brechfa, Carm. (Modern Game).
2nd, No. 385.—J. H. BAKER & SON, Windyash, Barnstaple. (Malay).
3rd, No. 382.—W. G. VIVIAN & SON, 5, Stanhope Square, Holsworthy, Devon. (Jersey Black Giant).
4th, No. 383.—H. HOUGH-WATSON, Braystones House, Beckermet. (Langshan).
H.C. No. 381.

Class 481.—*Any other Distinct Variety Heavy Hen or Pullet.*

1st, No. 390.—J. H. BAKER & SON, Windyash, Barnstaple. (Malay).
2nd, No. 389.—H. HOUGH-WATSON, Braystones House, Beckermet. (Langshan).
3rd, No. 386.—MAJOR G. T. WILLIAMS, Tredrea, Perranwell. (Frizzle).
4th, No. 388.—W. D. POTTER, Farmhouse, East Drive, Napsbury, St. Albans. (North Holland Blue).
R.N. No. 387.—W. G. VIVIAN & SON, 5, Stanhope Square, Holsworthy, Devon. (Jersey Black Giant).
H.C. No. 391.

Class 482.—*Any other Distinct Variety Light Cock or Cockerel.*

1st, No. 394.—H. HOUGH-WATSON, Braystones House, Beckermet. (Polish).
2nd, No. 395.—HARRY FOX, Richmond P.F., Matlock. (Red Cap).
3rd, No. 396.—MISS SEXTON, Cofield, Redhill. (O.E. Pheasant Fowl).
4th, No. 392.—W. H. LEESON, 91, Harnall Lane East, Coventry. (Gold Campine).
R.N. No. 393.—MAJOR G. T. WILLIAMS, Tredrea, Perranwell. (Polish).

Class 483.—*Any other distinct Variety Light Hen or Pullet.*

1st, No. 399.—H. HOUGH-WATSON, Braystones House, Beckermet. (Polish).
2nd, No. 400.—V. A. BAYLEY, Massey Farm, Upper Millichope, Church Stretton. (Black Spanish).
3rd, No. 398.—MAJOR G. T. WILLIAMS, Tredrea, Perranwell. (Polish).
4th, No. 397.—JOSEPH BLACKBURN, Craven Nursery, Thornton-in-Craven, Skipton. (Hamburgh).

Class 484.—*Light Hen that has secured the National Poultry Council Copper Ring.*

1st, No. 406 (White Leghorn), 3rd, No. 404 (Black Leghorn) and 4th, No. 401 (White Leghorn).—W. HAMNETT, Myrtle P.F., Breck Road, Poulton-le-Fylde.
2nd, No. 405.—W. BINNIE & SON, Garth House, Denny, Stirlingshire (White Leghorn).
R.N. No. 403.—OVALTINE POULTRY FARM, King's Langley, Herts. (White Leghorn).
H.C. No. 402.

Class 485.—*Heavy Hen that has secured the National Poultry Council Copper Ring.*

1st, No. 414 (Light Sussex), 2nd, No. 408 (White Wyandotte).—W. HAMNETT, Myrtle P.F., Breck Road, Poulton-le-Fylde.
3rd, No. 411.—HARRY FOX, Richmond P.F., Matlock. (White Wyandotte).
4th, No. 413.—F. J. MARSTON, The Biddenden P.F., Biddenden, Kent. (White Sussex).
R.N. No. 410.—OVALTINE POULTRY FARM, King's Langley, Herts. (Rhode Island Red).
H.C. No. 407. C. No. 409.

Class 487.—*Rhode Island Red Bantam Female.*

1st & Rhode Island Red Club's Special, No. 418, and 3rd, No. 415.—E. E. PICKERSGILL, Shenstone, Barton Court Road, New Milton, Hants.
2nd & R.N. for Special, No. 416.—JOHN KAY, Alderwood, Edenfield, Manchester.

Class 488.—*Indian Game or Jubilee Indian Game Bantam Male.*

1st, No. 423.—JAMES JOHNSON, Eastville, Liverpool Road, Burscough, Ormskirk.
2nd, No. 422.—P. J. PLATTEN, The Bluff, Griston, Thetford.
3rd & R.N. for Special, No. 419.—PERCY FRICKER, Blackness Farm, Crowborough, Sussex.
4th, No. 424.—W. R. BEER, Pill Dairy, Barnstaple.
R.N. No. 421.—MRS. H. A. CLIVE, The Hill House, Hartpury, Gloucester.
H.C. No. 425.

Class 489.—*Indian Game or Jubilee Indian Game Bantam Female.*

1st, No. 431.—JAMES JOHNSON, Eastville, Liverpool Road, Burscough, Ormskirk.
2nd & Jubilee Indian Game Club's Special, No. 428.—J. H. BAKER & SON, Windyash Barnstaple.
3rd, No. 430.—P. J. PLATTEN, The Bluff, Griston, Thetford.
4th, No. 427.—W. G. VIVIAN & SON, 5, Stanhope Square, Holsworthy, Devon.
R.N. No. 426.—PERCY FRICKER, Blackness Farm, Crowborough, Sussex.
H.C. Nos. 432, 433.

Class 494.—*Old English Game any other Colour Bantam Male.*

1st, No. 438.—SIDNEY NEWTON, Louwil Avenue, Mansfield Woodhouse, Notts.
2nd, No. 439.—J. H. BAKER & SON, Windyash, Barnstaple.
3rd, No. 435.—J. W. WHEELER, 33, Archer's Crescent, Ely, Cardiff.
4th, No. 437.—G. L. MASON, Myrtle Villa, Mewrd, Hillingdon Heath, Middlesex.
R.N. No. 436.—W. HARPER, Melrose, Garndiffaith, Pontypool.

Class 495.—*Old English Game any other Colour Bantam Female.*

1st, No. 443.—JOHN KAY, Alderwood, Edenfield, Manchester.
2nd, No. 448.—ROBERT KERR, Westcraig Loop Road, Whitehaven.
3rd, No. 441.—MISS M. WENGER, Trentham Priory, Stoke-on-Trent.
4th, No. 444.—SIDNEY NEWTON, Louwil Avenue, Mansfield Woodhouse, Notts.
R.N. No. 446.—W. HARPER, Melrose, Garndiffaith, Pontypool.
H.C. Nos. 442, 449. C. No. 440.

Class 496.—*Partridge Wyandotte Bantam Male.*

1st, No. 451.—E. Whitaker, Mayroyd House, Hebden Bridge, Yorks.
2nd, No. 450.—James Wallbank, Belmont, Longridge, Preston.
3rd, No. 454.—J. G. Morten, Pentrich, Derby.
4th, No. 453.—Keith Johnson, Eastville, Liverpool Road, Burscough, Ormskirk.

Class 497.—*Partridge Wyandotte Bantam Female.*

1st, No. 457.—Frank Norman, 17, Devon Place, Grangetown, Cardiff.
2nd, No. 456.—Major G. T. Williams, Tredrea, Perranwell.

Class 498.—*Wyandotte any other Colour Bantam Male.*

1st, No. 466.—James Johnson, Eastville, Liverpool Road, Burscough, Ormskirk.
2nd, No. 460.—E. Whitaker, Mayroyd House, Hebden Bridge, Yorks.
3rd, No. 464.—E. H. Clifford, 2, King Edward's Avenue, Gloucester.
4th, No. 465.—William Drew, 47, High Street, Hirwaun, Aberdare.
R.N. No. 463.—Sidney Newton, Louwil Avenue, Mansfield Woodhouse, Notts.
H.C. No. 459. **C.** No. 462.

Class 500.—*Sebright Bantam Male.*

1st, No. 468.—H. Hough Watson, Braystones House, Beckermet.
2nd, No. 467.—G. A. Drake, 37, North Street, Braunton, Devon.
3rd, No. 471.—C. I. Young, 6, Weymouth Road, Frome, Somerset.
4th, No. 469 & **R.N.** No. 472.—T. H. Sheldon, Cotham Manor, Newark.

Class 501.—*Sebright Bantam Female.*

1st, No. 474.—E. Whitaker, Mayroyd House, Hebden Bridge, Yorks.
2nd, No. 476.—T. H. Sheldon, Cotham Manor, Newark.
3rd, No. 475.—H. Hough-Watson, Braystones House, Beckermet.
4th, No. 473.—G. A. Drake, 37, North Street, Braunton, Devon.
R.N. No. 477.—C. I. Young, Cotham Manor, Newark.
H.C. No. 478.

Class 502.—*Any other variety Bantam Male.*

1st, No. 489.—James Johnson, Eastville, Liverpool Road, Burscough, Ormskirk. (Black Pekin).
2nd, No. 481.—A. E. Harris, Roclincourt, Cae, Brynton Road, Newport., Mon. (Black Rosecomb).
3rd, No. 482 (Polish), **4th,** No. 485 (Pekin).—H. Hough-Watson, Braystones House, Beckermet.
R.N. No. 487.—Mrs. L. Evill, Brynderwen, Chepstow. (Minorca).
H.C. Nos. 483, 488. **C.** No. 480.

Class 503.—*Any other variety Bantam Female.*

1st, No. 492 (Polish), **3rd,** No. 496 (Pekin).—H. Hough-Watson, Braystones House, Beckermet.
2nd, No. 491.—Major G. T. Williams, Tredrea, Perranwell. (Japanese).
4th, No. 495.—Mrs. L. Evill, Brynderwen, Chepstow. (Minorca).
R.N. No. 493.—Frank Norman, 17, Devon Place, Grangetown, Cardiff. (White Frizzle).
H.C. No. 494.

Class 506.—*Indian Runner Drake.*

1st, No. 501.—Rev. J. Hewetson, Burbage Vicarage, Buxton.
2nd, No. 497 & **3rd,** No. 502.—C. Cree, Moignes Court, Ower Moigne, Dorchester.
4th, No. 500.—H. Hough-Watson, Braystones House, Beckermet.
R.N. No. 499.—Reginald Appleyard, Priory Waterfowl Farms, Ixworth, Suffolk.

Class 507.—*Indian Runner Duck.*

1st, No. 504.—C. Cree, Moignes Court, Ower Moigne, Dorchester.
2nd, No. 507.—Rev. J. Hewetson, Burbage Vicarage, Buxton.
3rd, No. 506.—H. Hough-Watson, Braystones House, Beckermet.
4th, No. 505.—Reginald Appleyard, Priory Waterfowl Farms, Ixworth, Suffolk.

Class 508.—*Campbell Drake.*

1st, No. 509.—Reginald Appleyard, Priory Waterfowl Farms, Ixworth, Suffolk.

Class 509.—*Campbell Duck.*

1st, No. 513.—C. E. Booth, Henley, Bridgnorth.
2nd, No .512.—Reginald Appleyard, Priory Waterfowl Farms, Ixworth, Suffolk.
3rd, No. 514 & **4th,** No. 515.—John H. Butler, Gatcombe, Flax Bourton, Bristol.

Class 510.—*Any other variety Drake.*

1st, No. 520.—A. J. MAJOR, Ditton, Langley, Bucks. (Muscovy).
2nd, No. 517.—H. W. BIDDLECOMBE, Prestberries, Hartpury, Gloucester. (Cayuga).
3rd, No. 521.—RALPH ALTY, Mill House, Croston, Preston.
4th, No. 519.—REGINALD APPLEYARD Priory Waterfowl Farms, Ixworth, Suffolk. (Magpie).
R.N. No. 516.—R. BARKER, Lodge Farm, Long Eaton. (Magpie).
H.C. No. 522.

Class 511.—*Any other variety Duck.*

1st, No. 525.—REV. J. HEWETSON, Burbage Vicarage, Buxton.
2nd, No. 523.—R. BARKER, Lodge Farm, Long Eaton. (Magpie).
3rd, No. 526.—RALPH ALTY, Mill House, Croston, Preston.
4th, No. 524 (Muscovy) & **R.N.,** No. 527 (Cayuga).—REGINALD APPLEYARD, Priory Waterfowl Farms, Ixworth, Suffolk.

Class 513.—*Any other variety Gander or Goose.*

1st, No. 533 (Grey back Goose), **2nd,** No. 529 (White Chinese Gander) & **3rd,** No. 530 (White Chinese Goose).—REGINALD APPLEYARD, Priory Waterfowl Farms, Ixworth, Suffolk.
4th, No. 528 (Brecon Buff Gander) & **R.N.,** No. 531 (Brecon Buff Goose).—RHYS LLEWELLYN, St. Fagans Court, Glamorgan.
H.C. No. 532.

Class 514.—*Bronze Turkey Cock.*

1st, No. 535.—CAPT. B. T. DICKENSON, Raglands, Bishopstone, Salisbury.
2nd, No. 537.—E. P. WOOLLATT, Duntons Farm, Lavenham, Suffolk.
3rd, No. 538.—H. T. STONEX, Burlands Farm, Taunton.

Class 515.—*Bronze Turkey Hen.*

1st, No. 541.—E. P. WOOLLATT, Duntons Farm, Lavenham, Suffolk.
2nd, No. 539 & **3rd,** No. 542.—C. J. CHASE, Greystone, Hampton Lane, Solihull.

EGGS.

Unless otherwise stated the Prizes for Eggs are as follows: First Prize, 20s.; Second Prize, 15s.; Third Prize, 10s.; Fourth Prize, 5s.

Class 518.—*Twelve Hens' Eggs—Brown.*

1st, No. 2.—MISS CHARLOTTE FAWKES, Fern Bank Farm, Balsall Common, Coventry.
2nd, No. 5.—J. W. HIRD, Coppy House, Clapham, Lancaster.
3rd, No. 8.—F. MASSEY, Lindow Common, Wilmslow, Cheshire.
4th, No. 18 & **R.N.** No. 13.—A. PICKARD, Bull Ring, Nuneaton.
H.C. Nos. 7, 17. **C.** Nos. 4, 10.

Class 519.—*Twelve Hens' Eggs—White or Cream.*

1st, No. 20.—JOSEPH BLACKBURN, Craven Nursery, Thornton-in-Craven, Yorks. (White).
2nd, No. 28.—DENIS SHAKESHAFT, 25, The Circuit, Moor Lane, Wilmslow. (White).
3rd, No. 24.—DOUGLAS G. LACY.—Egg Packing Station, Loddington Poultry Farm, Bishop's Stortford. (White).
4th, No. 21.—MRS. DREDGE, Barton Farm, Holwell, Sherborne, Dorset. (Cream).
R.N. No. 23.—MISS EDITH JAMES, Llancayo, Usk, Mon. (White).

Class 520.—*Twelve Hens' Eggs—Tinted.*

1st, No. 30.—JOSEPH BLACKBURN, Craven Nursery, Thornton-in-Craven, Yorks.
2nd, No. 32.—MISS EDITH JAMES, Llancayo, Usk, Mon.
3rd, No. 31.—MRS. DREDGE, Barton Farm, Holwell, Sherborne, Dorset.
4th, No. 34.—B. W. MOORE, Ireton Wood, Idridgehay, Derby.
R.N. No. 33.—DOUGLAS G. LACY, Egg Packing Station, Loddington Poultry Farm, Bishop's Stortford.
H.C. No. 36. **C.** No. 38.

Class 521.—*Twelve Ducks' Eggs.*

1st, No. 45.—W. H. STEVENS, Brookfield, Sports Road, Glenfields, Leicester.
2nd, No. 40.—W. J. ASHWORTH, Read Wood Farm, Read, Burnley.
3rd, No. 46.—Studley College, Studley, Warws.
4th, No. 44.—MRS. DREDGE, Barton Farm, Holwell, Sherborne, Dorset.
R.N. No. 42.—JOHN H. BUTLER, Gatcombe, Flax Bourton, Bristol.

Class 522.—*One Pack of 15 dozen Eggs, statutory special grade, the produce of a producer-owned packing station.*

1st, 50s. No. 49.—EAST ANGLIAN EGG PACKING STATION, LTD., Paddock Street, Soham, Ely, Cambs.
2nd, 40s. No. 50.—DOUGLAS G. LACY, Egg Packing Station, Loddington Poultry Farm, Bishop's Stortford.
3rd, 20s. No. 48.—BANBURY EGG PRODUCERS, LTD., 63, George Street, Banbury.
4th, 10s. No. 51.—SOMERSET POULTRY MARKETING ASSOCIATION, LTD., Eastfields Farm, Edington, Bridgwater.

Class 523.—*One Pack of 15 dozen Eggs, statutory standard grade, the produce of a producer-owned packing station.*

1st, 50s. No. 54.—DOUGLAS G. LACY, Egg Packing Station, Loddington Poultry Farm, Bishop's Stortford.
2nd, 40s. No. 53.—EAST ANGLIAN EGG PACKING STATION, LTD., Paddock Street, Soham, Ely, Cambs.
3rd, 20s. No. 56.—SOMERSET POULTRY MARKETING ASSOCIATION, LTD., Eastfields Farm, Edington, Bridgwater.
4th, 10s. No. 52.—BANBURY EGG PRODUCERS, LTD., 63, George Street, Banbury.
R.N. No. 55.—JOHN PERCIVAL, Easthouse, Carperby, Yorkshire.

FARM AND DAIRY PRODUCE OF THE UNITED KINGDOM.

Butter.

The Prizes for Butter are as follows: First Prize, £3; Second Prize, £2; Third Prize, £1; Fourth Prize, 10s.

Class 524.—*Two Pounds of Fresh Butter without any salt, made up in plain pounds, from the milk of Channel Island, Devon or South Devon Cattle and their crosses.*

1st, No. 59.—MISS M. W. GWENNAP, Boconnoc, Lostwithiel, Cornwall.
2nd, No. 58.—A. G. DENNIS, Lower Pulworthy, Highampton, Beaworthy, Devon.
3rd, No. 57.—MRS. G. BLACKLER, West Leigh, Modbury, South Devon.
R.N. No. 60.—MRS. J. MOGFORD, Overcott, Rose Ash, South Molton, Devon.
H.C. Nos. 61, 63.

Class 525.—*Two Pounds of Fresh Butter without any salt, made up in plain pounds, from the milk of cattle of any breed or cross other than those mentioned in Class 524.*

1st, & **£5** Champion, No. 70.—MISS A. M. WARD, Foggathorpe Hall, Selby, Yorks.
2nd, No. 64.—MRS. B. DENNIS, Pulworthy, Highampton, Beaworthy, Devon.
3rd, No. 68.—Mrs. W. LAWSON, Wyre Farm, Scorton, Preston.
R.N. No. 67.—MISS RACHEL JAMES, Llancayo, Usk, Mon.
H.C. No. 69.

Class 526.—*Two Pounds of Fresh Butter, slightly salted, made up in plain pounds, from the milk of Channel Island, Devon or South Devon Cattle and their crosses.*

1st & R.N. for Champion, No. 78.—MISS OLIVE F. WAY, West Bridge, Bishopsnympton, South Molton, Devon.
2nd, No. 72.—A. G. DENNIS, Lower Pulworthy, Highampton, Beaworthy, Devon.
3rd, No. 71.—MRS. G. BLACKLER, West Leigh, Modbury, South Devon.
R.N. No. 75.—MRS. J. MOGFORD, Overcott, Rose Ash, South Molton, Devon.
H.C. No. 74. **C.** Nos. 73, 76.

Class 527.—*Two Pounds of Fresh Butter, slightly salted, made up in plain pounds, from the milk of cattle of any breed or cross other than those mentioned in Class 526.*

1st, No. 79.—MRS. B. DENNIS, Pulworthy, Highampton, Beaworthy, Devon.
2nd, No. 87.—MISS A. M. WARD, Foggathorpe Hall, Selby, Yorks.
3rd, No. 82.—MRS. W. LAWSON, Wyre Farm, Scorton, Preston.
4th, No. 81.—MISS RACHEL JAMES Llancayo, Usk, Mon.
R.N. No. 83.—MRS. D. W. LLOYD, Cefngwernfa, Tregynon, Newtown, Mont.
H.C. Nos. 84, 86.

Class 528.—*Three Pounds of Fresh Butter, slightly salted, made up in pounds in the most attractive marketable designs.*

1st, No. 88.—Miss M. W. Gwennap, Boconnoc, Lostwithiel, Cornwall.
2nd, No. 93.—Miss Olive F. Way, West Bridge, Bishopsnympton, South Molton, Devon.
3rd, No. 89.—Mrs. J. Mogford, Overcott, Rose Ash, South Molton, Devon.
R.N. No. 90.—J. Pierpont Morgan, Wall Hall, Aldenham, Watford.

Cheese.

Made in 1938.

Unless otherwise stated, the Prizes for Cheese are as follows: First Prize, £5; Second Prize, £3; Third Prize, £2; Fourth Prize, 10s.

Class 529.—*Two Cheshire Cheeses (Coloured) not less than 40 lb. each, made by a farmer-producer.*

1st, No. 109.—A. E. Walley, Bickerton Hall, Malpas.
2nd, No. 107.—J. D. Goodwin, Ash House Farm, Brindley, Nantwich.
3rd, No. 106.—W. E. Blake, Cross Lanes, Bickley, Malpas.
R.N. No. 110.—P. H. Walley, Towns Green, Wettenhall, Winsford, Cheshire.

Class 530.—*Two Cheshire Cheeses (un-Coloured), not less than 40 lb. each, made by a farmer-producer.*

1st, No. 114.—P. H. Walley, Towns Green, Wettenhall, Wensford, Cheshire.
2nd, No. 113.—W. H. Hobson, Woodhey Hall, Nantwich.
3rd, No. 111.—W. E. Blake, Cross Lanes, Bickley, Malpas.
R.N. No. 112.—J. D. Goodwin, Ash House Farm, Brindley, Nantwich.

Class 531.—*Two Cheshire Cheeses (Coloured or un-Coloured). not less than 40 lb. each, made by a farmer-producer who has not won a 1st, 2nd or 3rd Prize at the Royal Show for the last five years.*

1st, No. 115.—J. N. Bourne, Manor Farm, Harthill, Chester.
2nd, No. 116.—J. D. Goodwin, Ash House Farm, Brindley, Nantwich.

Class 532.—*Two Cheshire Cheeses (Coloured), not less than 40 lb. each, restricted to factory-made Cheese.*

1st, No. 119.—The Dee Vale Dairy Co., Ltd., Sandycroft, Chester.
2nd, No. 118.—B. S. Bostock, Ltd., Mere Field Dairy, Haslington, Crewe.
3rd, No. 117.—Ann's Farmhouse, Cropwell Bishop, Notts.

Class 533.—*Two Cheshire Cheeses (un-Coloured), not less than 40 lb. each, restricted to factory-made Cheese.*

1st, No. 121.—B. S. Bostock, Ltd., Mere Field Dairy, Haslington, Crewe.
2nd, No. 120.—Ann's Farmhouse, Cropwell Bishop, Notts.

Class 534.—*Two Cheddar Cheeses, not less than 50 lb. each.*

1st, No. 128.—Sidney T. White, Lock Dennis Farm, Ilchester.
2nd, No. 127.—B. H. J. W. White, Hill View Farm, Bruton, Somerset.
3rd, No. 123.—R. G. Mapstone, Northload Hall Farm, Glastonbury.
R.N. No. 122.—Ann's Farmhouse, Cropwell Bishop, Notts.
H.C. No. 125.

Class 535.—*Two Cheddar Cheeses, not more than 50 lb. each.*

1st, No. 132.—Frank Portch, Leigh Farm, Wincanton, Somerset.
2nd, No. 133.—B. H. J. W. White, Hill View Farm, Bruton, Somerset.
3rd, No. 130.—Nelson Osborne, Rectory Farm, Charlton Musgrove, Wincanton, Somerset.
R.N. No. 134.—Sidney T. White, Lock Dennis Farm, Ilchester.
H.C. No. 129.

Class 536.—*Two Loaf or other Cheddar Truckles.*

1st, No. 143.—Sidney T. White, Lock Dennis Farm, Ilchester.
2nd, No. 142.—B. H. J. W. White, Hill View Farm, Bruton, Somerset.
3rd, No. 136.—Chedder Vale Dairy Co., Ltd., Rooksbridge, Axbridge.
R.N. No. 140.—Frank Portch, Leigh Farm, Wincanton, Somerset.
H.C. No. 135.

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Class 537.—*Two Stilton Cheeses.*

1st, No. 144.—EMBERLIN & CO., LTD., Old Dalby, Melton Mowbray.
2nd, No. 150.—EMBERLIN & CO., LTD., Wymeswold, Loughborough.
3rd, No. 146.—J. M. NUTTALL & CO., LTD., Dove Dairy, Hartington, Buxton.
R.N. No. 147.—SCALFORD DAIRY, LTD., Scalford, Melton Mowbray.
H.C. No. 145.

Class 538.—*Two Wensleydale Cheeses (Stilton shape).*

1st, No. 155.—ALFRED ROWNTREE & SONS, Coverham, Middleham, Yorks.
2nd, No. 154.—J. M. NUTTALL & CO., LTD., Dove Dairy, Hartington, Buxton.
3rd, No. 152.—MISS RACHEL JAMES, Llancayo, Usk, Mon.
R.N. No. 153.—MISS B. J. MUDD, Aldborough Dairy, Boroughbridge, Yorks.

Class 539.—*Two Double Gloucester Cheeses, from 24 to 30 lb. each.*

1st, No. 156.—ANN'S FARMHOUSE, Cropwell Bishop, Notts.
2nd, No. 157.—CHEDDAR VALLEY DAIRY CO., LTD., Rooksbridge, Axbridge.
3rd, No. 158.—NELSON OSBORNE, Rectory Farm, Charlton Musgrove, Wincanton, Somerset.
R.N. No. 159.—H. H. PICKFORD, Patney, Devizes.

Class 540.—*Two Single Gloucester Cheeses, from 12 to 16 lb. each.*

1st, No. 160.—ANN'S FARMHOUSE, Cropwell Bishop, Notts.
2nd, No. 161.—H. H. PICKFORD, Patney, Devizes.

Class 541.—*Two Leicestershire Cheeses.*

1st, No. 162.—ANN'S FARMHOUSE, Cropwell Bishop, Notts.
2nd, No. 163.—FRANCIS W. TOMLINSON, Hall Farm, Ullesthorpe, Rugby.
3rd, No. 165.—TUXFORD & TEBBUTT, LTD., Thorpe End, Melton Mowbray.
R.N. No. 164.—STEPHEN TRUELOVE, Gate Farm, Monks Kirby, Rugby.

Class 542.—*Two Caerphilly Cheeses, about 9 lb. each, above 3 and not exceeding 4 inches in thickness.*

1st, No. 172.—WEST OF ENGLAND CREAMERY, Highbridge, Somerset.
2nd, No. 167.—CHEDDAR VALLEY DAIRY CO., LTD., Rooksbridge, Axbridge.
3rd, No. 166.—L. T. BELL, Athelney Farm, Athelney, Bridgwater, Somerset.
R.N. No. 170.—R. G. MAPSTONE, Northload Hall Farm, Glastonbury.

Class 543.—*Two Caerphilly Cheeses, about 6 lb. each, not exceeding 3 inches in thickness.*

1st, No. 178.—R. G. MAPSTONE, Northload Hall Farm, Glastonbury.
2nd, No. 179.—MISS HILDA E. MESSENGER, Kemeys Commander, Usk, Mon.
3rd, No. 182.—WEST OF ENGLAND CREAMERY, Highbrigde, Somerset.
4th, No. 174.—CHEDDAR VALLEY DAIRY CO., LTD., Rooksbridge, Axbridge.
R.N. No. 173.—L. T. BELL, Athelney Farm, Athelney, Bridgwater, Somerset.
H.C. No. 180.

Class 544.—*Two Small Cheeses, not exceeding 6 lb. each, of Cheddar or Cheshire character.*

1st, £3. No. 188.—FRANK PORTCH, Leigh Farm, Wincanton, Somerset.
2nd, £2. No. 189.—P. H. WALLEY, Towns Green, Wettenhall, Winsford, Cheshire.
3rd, £1. No. 186.—NELSON OSBORNE, Rectory Farm, Charlton Musgrove, Wincanton, Somerset.
4th, 10s. No. 184.—J. D. GOODWIN, Ash House Farm, Brindley, Nantwich.
R.N. No. 191.—SIDNEY T. WHITE, Sock Dennis Farm, Ilchester.
H.C. No. 190.

Class 545.—*Two Small Cheeses, not exceeding 6 lb. each, of Stilton or Wensleydale character.*

1st, £3. No. 194.—J. M. NUTTALL & CO., LTD., Dove Dairy, Hartington, Buxton.
2nd, £2. No. 196.—TUXFORD & TEBBUTT, LTD., Thorpe End, Melton Mowbray.
3rd, £1. No. 195.—ALFRED ROWNTREE & SONS, Coverham, Middleham, Yorks.
R.N. No. 193.—MISS B. J. MUDD, Aldborough Dairy, Boroughbridge, Yorks.

Class 546.—*Two Soft Cheeses, made from whole milk.*

1st, £3, No. 199.—MISS RACHEL JAMES, Llancayo, Usk, Mon.
2nd, £2. No. 198.—MISS E. M. ALLDAY, Manor Farm, Fotheringhay, Peterborough.
3rd, £1. No. 200.—MONMOUTHSHIRE INSTITUTE OF AGRICULTURE, Usk.

Class 547.—*Two Cheeses, made from Cream without the addition of Rennet.*

1st, £3. No. 202.—MISS RACHEL JAMES, Llancayo, Usk, Mon.
2nd, £2. No. 206.—MRS. J. T. ROGERS, Llanwinney Farm, Llangovan, Monmouth.
3rd, £1. No. 203.—MONMOUTHSHIRE INSTITUTE OF AGRICULTURE, Usk.
R.N. No. 204.—CAPT. & MRS. V. MORSE, Upper Cowden, Five Ashes, Sussex.

Cider.

The Prizes for Cider are as follows: First Prize, £3; Second Prize, £2; Third Prize, £1; Fourth Prize, 10s.; Fifth Prize, 5s.

Class 548.—*Cask of Cider, not less than* 6 *gallons, made in* 1937 *by an exhibitor whose main occupation is farming.*

1st, No. 224.—S. J. SHEPPY, Three Bridges, Taunton.
2nd, No. 223.—H. H. SEALY & SON, Honeyhurst Farm, Rodney Stoke, Cheddar.

Class 549.—*Cask of Cider, not less than six gallons, made in* 1937.

1st, No. 234.—S. J. SHEPPY, Three Bridges, Taunton.
2nd, No. 231.—PULLIN BROS., Spaniorum Farm, Compton Greenfield, Bristol.

Class 550.—*Six Bottles of Cider, made in* 1937 *by an exhibitor whose main occupation is farming.*

1st, No. 240.—H. H. SEALY & SON, Honeyhurst Farm, Rodney Stoke, Cheddar.
2nd, No. 236.—D. J. CROFTS, Sutton Farm, Sutton Montis, Yeovil.
3rd, No. 242.—HARRY E. R. WARREN, Highfield Farm, Netherbury, Dorset.
R.N. No. 241.—S. J. SHEPPY, Three Bridges, Taunton.

Class 551.—*Six Bottles of Dry Cider, made in* 1937.

1st, No. 250.—QUANTOCK VALE CIDER CO., LTD., North Petherton, Bridgwater, Somerset.
2nd, No. 246.—HORRELL & SON, Bridge Farm, Stoke Canon, Devon.
3rd, No. 244 & R.N. No. 245.—GLOUCESTERSHIRE CIDER CO., LTD., Wickware, Glos.
4th, No. 253.—S. J. SHEPPY, Three Bridges, Taunton.
5th, No. 254.—STYLE & WINCH, LTD., Dover Place, Ashford, Kent.

Class 552.—*Six Bottles of Sweet Cider, made in* 1937.

1st, No. 255.—D. J. CROFTS, Sutton Farm, Sutton Montis, Yeovil.
2nd, No. 256.—H. W. DAVIS, Sutton Montis, Yeovil.
3rd, No. 265 & 5th, No. 266.—QUANTOCK VALE CIDER CO., LTD., North Petherton.
4th, No. 263 & R.N., No. 264.—PULLIN BROS., Spaniorum Farm, Compton, Greenfield, Bristol.

Class 553.—*Six Bottles of Cider, made previous to* 1937.

1st, No. 283.—HARRY E. R. WARREN, Highfield Farm, Netherbury, Dorset.
2nd, No. 282.—S. J. SHEPPY, Three Bridges, Taunton.
3rd, No. 278.—PULLIN BROS., Spaniorum Farm, Compton Greenfield, Bristol.
4th, No. 280.—H. H. SEALY & SON, Honeyhurst Farm, Rodney Stoke, Cheddar.
5th, No. 273.—GLOUCESTERSHIRE CIDER CO., LTD., Wickwar, Glos.
R.N. No. 279.—QUANTOCK VALE CIDER CO., LTD., North Petherton, Bridgwater, Somerset.

Class 554.—*Six Bottles of Cider, bearing the national mark, made in* 1937.

1st, No. 293.—H. H. SEALY & SON, Honeyhurst Farm, Rodney Stoke, Cheddar.
2nd, No. 284.—D. J. CROFTS, Sutton Farm, Sutton Montis, Yeovil.
3rd, No. 285.—HORRELL & SON, Bridge Farm, Stoke Canon, Devon.
4th, No. 292 & R.N., No. 291.—QUANTOCK VALE CIDER CO., LTD., North Petherton, Bridgwater, Somerset.
5th, No. 286.—LYTHECOURT CIDER PRESS, Knightshayes Estate Office, Tiverton.
H.C. No. 287.

Wool.

Of 1938 clip.

First Prize, £3; Second Prize, £2; Third Prize, £1.

Class 555.—*Three Fleeces of Oxford Down.*

1st, No. 301 & 2nd, No. 300.—HUGH WILLIAM STILGOE, The Grounds, Adderbury, Banbury.
3rd, No. 298.—T. W. MONTAGUE PERKINS, Ufton Court, Holme Lacy, Hereford.
R.N. No. 297.—HOBBS & DAVIS, Kelmscott, Lechlade.

Class 556.—*Three Fleeces of Shropshire.*

1st, No. 302.—JOHN M. BELCHER, Tibberton Grange, Wellington, Shropshire.
2nd, No. 305 & R.N., No. 304.—MRS. M. C. INGE, Thorpe Hall, Tamworth.
3rd, No. 303.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.

Class 557.—*Three Fleeces of Southdown.*

1st, No. 314.—JOE K. WILLIAMSON, Derwen Hall, Ruthin.
2nd, No. 312 & R.N., No. 311.—HERBERT D. SHIELDS, Borderlands, Culford, Suffolk.
3rd, No. 307.—LADY LUDLOW, Luton Hoo, Luton, Beds.
4th, 10s., No. 306.—H. W. DAVEY, Maesmynan, Caerwys Station.
H.C. No. 308.

Class 558.—*Three Fleeces of Hampshire Down.*

1st, No. 317 & R.N., No. 318.—WILLIAM TODD, Little Ponton Grange, Grantham.
2nd, No. 316.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
3rd, No. 320.—PERCY C. TORY, Shapwick, Blandford.
H.C. No. 315.

Class 559.—*Three Fleeces of Suffolk.*

1st & "Merchants of the Staple of England" Special, No. 321.—SIR PRINCE PRINCE-SMITH, BT., Southburn, Driffield.

Class 560.—*Three Fleeces of Dorset Down.*

1st, No. 325 & R.N. No. 324.—LEONARD TORY, Turnworth, Blandford.
2nd, No. 326.—COL. H. S. WOODHOUSE, West Lodge, Iwerne Minster, Blandford.
3rd, No. 323.—HOOPER BROS., Newburgh, Winfrith, Dorchester.

Class 561.—*Three Fleeces of Dorset Horn.*

1st, No. 329 & 2nd, No. 328.—C. J. HAMBRO, Hedge End Farm, Blandford.
3rd, No. 327.—WILFRED V. CAKE, Lower Burton, Dorchester.

Class 562.—*Three Fleeces of Ryeland.*

1st, No. 333 & 3rd, No. 334.—T. W. MONTAGUE PERKINS, Ufton Court, Holme Lacy, Hereford.
2nd, No. 336.—DAVID J. THOMAS, Monachty, Abergavenny.
R.N. No. 330.—EXORS. OF LORD CAWLEY, Berrington Hall, Leominster.
H.C. No. 332.

Class 563.—*Three Fleeces of Kerry Hill (Wales).*

1st & R.N. for "Merchants of the Staple of England," Special, No. 338 & 2nd, No. 339.—JOHN BEAVAN, Winsbury, Chirbury, Montgomery.
3rd, No. 341 & R.N., No. 340.—JOHN W. OWENS, Woodhouse, Shobdon, Leominster.

Class 564.—*Three Fleeces of Clun Forest.*

1st, No. 346 & 3rd, No. 345.—T. E. GWILLIM, Ffostill, Talgarth, Brecon.
2nd, No. 344.—T. R. ECKLEY, Court Llacca, Brecon.
R.N. No. 348.—W. T. MORRIS, Yatton Farm, Aymestrey, Leominster.
H.C. 347.

Class 565.—*Three Fleeces of Lincoln.*

1st, No. 351.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
2nd, No. 350.—D. F. BROWETT, Frith Farm, Little Casterton, Stamford.

Class 566.—*Three Fleeces of Wensleydale.*

1st & "Merchants of the Staple of England" Special, No. 354.—JOHN PERCIVAL, Easthouse, Carperby, Yorks.
2nd, No. 355.—J. B. SMALLEY, Birkby Hall, Cark-in-Cartmel.
3rd, No. 353.—T. B. EARLE, Bolton Grange, Scorton, Richmond, Yorks.

Class 567.—*Three Fleeces of Kent or Romney Marsh, Rams of any age.*

1st & R.N. for "Merchants of the Staple of England" Special, No. 358.—ASHLEY STEVENS, Davington Hall, Faversham.
2nd, No. 357.—J. EGERTON QUESTED., The Firs, Cheriton, Kent.
3rd, No. 356.—E. W. BAKER, Parsonage Farm, Bekesbourne, Canterbury.

Class 568.—*Three Fleeces of Kent or Romney Marsh, Ewe Tegs.*

1st, No. 360.—MALCOLM KEMP, Leyton House, Rolvenden, Kent.
2nd, No. 362.—J. EGERTON QUESTED, The Firs, Cheriton, Kent.
3rd, No. 363.—ASHLEY STEVENS, Davington Hall, Faversham.
R.N. No. 359.—E. W. BAKER, Parsonage Farm, Bekesbourne, Canterbury.
H.C. No. 361.

Class 569.—*Three Fleeces of Kent or Romney Marsh, excluding Rams and Ewe Tegs.*

1st, No. 367.—ASHLEY STEVENS, Davington Hall, Faversham.
2nd, No. 365.—MALCOLM KEMP, Leyton House, Rolvenden, Kent.
3rd, No. 364.—E. W. Baker, Parsonage Farm, Bekesbourne, Canterbury.
R.N. No. 366.—J. EGERTON QUESTED, The Firs, Cheriton, Kent.

Class 570.—*Three Fleeces of Welsh Mountain.*

1st, No. 375.—JOE K. WILLIAMSON, Derwen Hall, Ruthin.
2nd, No. 371.—WILFRED ROBERTS, Tregynan Uchaf, Llanrhystyd, Cards.
3rd, No. 373.—UNIVERSITY COLLEGE OF NORTH WALES, Bangor.
R.N. No. 370.—JOHNNY PRICE, Tanyfedw, Sennybridge, Brecon.
H.C. No. 374.

Class 571.—*Three Fleeces of Black Welsh Mountain.*

1st, No. 379 & 3rd, No. 378.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn.
2nd, No. 376.—THE HON. MRS. C. BEHRENS, Swinton Grange, Malton, Yorks.
R.N. No. 377.—MAJOR J. A. HERBERT, M.P., Llanover, Abergavenny.

BUTTER-MAKING COMPETITIONS.

Class 1.—*Open to Students who have attended a course at any Dairy School or Class in Wales or Monmouthshire, and who have not won a First Prize at any Show.*

Section A.

1st, £4. No. 1.—MISS OLWEN ALLEN, Tynycana, Glascoed, Pontypool.
2nd, £3. No. 18.—MISS GWYNETH LLOYD, The Home Farm, Norton, Presteigne.
3rd, £2. No. 3.—MISS LILIAN BELBEN, Monmouthshire Institute of Agriculture, Usk.
4th, £1. No. 13.—MISS PAT JENKINS, Monachty Farm, Little Mill, Pontypool.
R.N. No. 14.—MISS MYRA JONES, Porth-y-Morddwr, Bronllys, Talgarth.
H.C. Nos. 6, 9.

Section B.

1st, £4. No. 35.—MISS MONA M. WILLIAMS, Cae-Caradog Farm, St. Brides Major, Bridgend.
2nd, £3. No. 20.—MISS HELEN MILES, Monmouthshire Institute of Agriculture, Usk.
3rd, £2. No. 22.—PETER PINKNEY, Monmouthshire Institute of Agriculture, Usk.
4th, £1. No. 29.—MISS MILDRED TAYLOR, Goldwyre Lane, Over Monnow, Monmouth.
R.N. No. 32.—MISS KATHLEEN WILLIAMS, Penywein Farm, Cymyoy Lower, Abergavenny.
H.C. Nos. 30, 33. C. Nos. 25, 26.

Class 2.—*Open to Students who have received not less than one month's instruction at any Dairy School and who have not won a First or Second Prize at the R.A.S.E., London Dairy, Bath & West, Royal Counties, Three Counties, Royal Welsh, Royal Lancashire or Yorkshire Shows.*

1st, £4. No. 56.—MISS MARGARET VELLENOWETH, Perranuthnoe, Marazion, Cornwall.
2nd, £3. No. 47.—MISS HELEN MILES, Monmouthshire Institute of Agriculture, Usk.
3rd, £2. No. 59.—MISS PEGGY WEST, Hay, Wadebridge, Cornwall.
4th, £1. No. 60.—MISS HESTER WILDING, Old Impton, Norton, Presteigne.
R.N. No. 48.—MISS MAY NEVILLE, Dovehills, Bishops Frome, Worcs.
H.C. Nos. 38, 44, 46, 49, 50, 61. C. Nos. 42, 45, 54.

Class 3.—*Open to those who have not won a First or Second Prize at any Show.*

1st, £4. No. 77.—MISS MARGARET VELLENOWETH, Perranuthnoe, Marazion, Cornwall.
2nd, £3. No. 64.—MISS MARY DAVIES, Petershall Farm, Kimbolton, Leominster.
3rd, £2. No. 71.—MISS MAY NEVILLE, Dovehills, Bishops Frome, Worcs.
4th, £1. No. 76.—MISS ELSIE DOREEN RICHARDS, Trengove Farm, Illogan, Redruth, Cornwall.
R.N. No. 68.—MISS VENICE KNIGHT, Middlefield Gate, Sutton St. Nicholas, Hereford,
H.C. Nos. 67, 70, 73, 78. C. Nos. 63, 66, 80.

Class 4.—*Open, except to Champions at the R.A.S.E., London Dairy, Bath and West, Royal Counties, Royal Lancashire or Yorkshire Shows.*

Section A.

1st, £5. No. 93.—Miss E. J. Eustice, Bezurrel, Gwinear, Hayle, Cornwall.
2nd, £4. No. 81.—Miss Edytha H. Eustice, Tappard, Gwinear, Hayle, Cornwall.
3rd, £3. No. 84.—Miss A. J. Brush, West Trefula, Redruth, Cornwall.
4th, £2. No. 95.—Miss M. W. Gwennap, Boconnoc, Lostwithiel, Cornwall.
5th, £1. No. 96.—Miss Nancy Heath, Monmouthshire Institute of Agriculture, Usk.
R.N. No. 87.—Miss Kathleen Curnow, Treveor, Tressillian, Truro.
H.C. Nos. 86, 91, 101. **C.** No. 100.

Section B.

1st, £5. No. 120.—Miss Peggy West, Hay, Wadebridge, Cornwall.
2nd, £4. No. 107.—Miss P. Peer, Rectory Farm, Tibberton, Droitwich.
3rd, £3. No. 104.—Miss Violet Jones, Forest Hall, Whitchurch, Cardiff.
4th, £2. No. 109.—Miss Dorothy M. Powell, Maerdy, Lower Maescoed, Pontrilas, Hereford.
5th, £1. No. 106.—Miss Gwendoline G. Olde, Clifton House, Boscastle, Cornwall.
R.N. No. 117.—Miss Margaret Vellenoweth, Perranuthnoe, Marazion, Cornwall.
H.C. Nos. 108, 114, 118. **C.** Nos. 111, 119.

Class 5.—*Inter-County Championships for teams of three, one of whom must be a Novice never having won a First or Second Prize up to the time of entry, the second member must not have won more than three First Prizes and must never have won any Championship, the third member may be a Champion at this or any Show.*

1st, £3 & Silver Medal each, No. 123.—Miss Elsie Doreen Richards, Trengove Farm, Illogan, Redruth; Miss M. W. Gwennap, Boconnoc, Lostwithiel; and Miss Monica M. Olde, Clifton House, Boscastle (Cornwall).
2nd, £2 each. No. 127.—Miss Olwen Allen, Tynycaua, Glascoed, Pontypool; Miss Nancy Heath, Monmouthshire Institute of Agriculture, Usk; and Miss Flossie Lewis, Court Farm, Llanmartin, Newport (Monmouthshire).
3rd, £1 each. No. 124.—Miss Mona M. Williams, Cae-Caradog Farm, St. Brides Major, Bridgend; Miss Cissie James, Sheepcourt Farm, Bonvilston, Cardiff; and Miss Violet Jones, Forest Hall, Whitchurch, Cardiff (Glamorganshire).
R.N. No. 122.—Miss Myra Jones, Porth-y-Morddwr, Bronllys, Talgarth; Miss Myra Davies, Llanddew Court, Brecon; and Miss Mary Hopkins, Bronllys Court, Talgarth (Breconshire).
H.C. No. 129.

Class 6.—*Championship open to the First Prize Winners in Classes* 1 *to* 5 *or at any previous Royal Show, and to Champions of the London Dairy, Bath and West, Royal Counties, or any County Show.*

1st, £5 & Gold Medal. No. 138.—Miss P. Peer, Rectory Farm, Tibberton, Droitwich.
2nd, £4. No. 137.—Miss Monica M. Olde, Clifton House, Boscastle, Cornwall.
3rd, £3. No. 136.—Miss Flossie Lewis, Court Farm, Llanmartin, Newport, Mon.
4th, £2. No. 123.—Miss M. W. Gwennap, Boconnoc, Lostwithiel, Cornwall.
5th, £1. No. 135.—Miss Marie Julian, Tredinnick Farm, Duloe, Liskeard, Cornwall.
R.N. No. 120.—Miss Peggy West, Hay, Wadebridge, Cornwall.
H.C. Nos. 93, 131, 134.

FLOWER SHOW.

No. 10.—**Challenge Cup,** presented by Lady Carr, for best collection in Class 5 to Bees, Ltd., Sealand Nurseries, Chester.
No. 13.—**R.N. for Challenge Cup** to Suffolk Seed Stores, Ltd., Woodbridge.
No. 14.—**Challenge Cup,** presented by Lady Daresbury, **"Lascelles Carr" Memorial Tray,** for best collection in Class 6; and the **Welsh National Carnation Society's Shield** for best collection of carnations in Classes 6 and 7 to C. Engelmann, Ltd., Saffron Walden, Essex.
No. 15.—**R.N. for Challenge Cup Memorial Tray and Shield** to Stuart Low Co., Bush Hill Park, Enfield, Middlesex.
No. 24.—**The "Bute" Challenge Cup** for best collection of Cut Roses in Class 9 to Thos. Robinson, Porchester Nurseries, Nottingham.
No. 23.—**R.N. for Challenge Cup** to Wm. Lowe & Son (Nurseries), Ltd., The Nurseries, Beeston, Notts.

Class 1.—*Group of Miscellaneous Plants in and out of Bloom.*

1st, £40. No. 1.—James Cypher & Sons, Ltd., Queen's Road Nurseries, Cheltenham.
2nd, £30. No. 2.—T. M. Petch, Highfield Nursery, 92, Poplar Grove, Great Horton, Bradford.
3rd, £15. No. 3.—F. Whitehead, 46, Podsmead Road, Gloucester.

Class 2.—*Collection of Delphiniums.*

1st, £8. No. 4.—Blackmore & Langdon, Bath.

Class 3.—*Group of Tuberous Begonias in Pots.*

1st, £20. No. 5.—Blackmore & Langdon, Bath.
2nd, £15. No. 6.—H. Woolman, Shirley, Birmingham.

Class 4.—*Group of Aquatic and semi-Aquatic Plants.*

1st, £20. No. 7.—Hillier & Sons, West Hill Nurseries, Winchester.
2nd, £15. No. 8.—M. Prichard & Sons, Ltd., Riverslea Nurseries, Christchurch, Hants.
3rd, £10. No. 9.—Stephen Sims, Draycott, Derbyshire.

Class 5.—*Collection of Hardy Perennial Plants and Cut Blooms (Roses and Shrubs excluded).*

1st, £30. No. 10.—Bees, Ltd., Sealand Nurseries, Chester.
2nd, £25. No. 13.—Suffolk Seed Stores, Ltd., Woodbridge.
3rd, £20. No. 11.—Gayborder Nurseries, Melbourne, Derbyshire.

Class 6.—*Collection of Tree Carnations.*

1st, £15. No. 14.—C. Engelmann, Ltd., Saffron Walden, Essex.
2nd, £10. No. 15.—Stuart Low Co., Bush Hill Park, Enfield, Middlesex.

Class 7.—*Collection of Cut Sprays of Border Carnations.*

1st, £15. No. 16.—Horace Lakeman, Queensberry Nursery, Thornton Heath, Surrey.

Class 8.—*Collection of Sweet Peas.*

1st, £15. No. 17.—G. H. Brookshaw, Stock Lane, Hough, Crewe.

Class 9.—*Collection of Cut Roses.*

1st, £15. No. 24.—Thos. Robinson, Porchester Nurseries, Nottingham.
2nd, £10. No. 23.—Wm. Lowe & Son (Nurseries), Ltd., The Nurseries, Beeston, Notts.
3rd, £7. No. 25.—Stephen Treseder & Son, Ely Nurseries, Ely, Cardiff.
4th, £5. No. 22.—William Hill & Son, The Floral Nurseries, Ely, Cardiff.

Exhibits not for Competition.

Large Gold Medals to :—

No. 26.—Allwood Bros., Wivelsfield Nurseries, Haywards Heath. (Carnations and Pinks.)
No. 57.—John Peed & Son, West Norwood, London, S.E.27. (Stove and Greenhouse Plants.)
No. 67.—Studley College, Warwickshire. (Fruit and Vegetables.)
No. 68.—B. Thurston & Sons, The Nurseries, Dinas Powis. (Rock and Water Garden.)

Gold Medals to :—

No. 28.—Bakers, Codsall, Wolverhampton. (Delphiniums and Lupins.)
No. 33.—Frank Cant & Co., Ltd., Braiswick Rose Gardens, Colchester. (Cut Roses.)
No. 34.—W. A. Constable, Ltd., Southborough, Tunbridge Wells. (Lilies and Bulbous Plants.)
No. 37.—Alex. Dickson & Sons, Ltd., Hawlmark, Marks Tey, Essex; and Newtownards, N. Ireland. (Roses.)
No. 39.—Forest & Orchard Nurseries, Ltd., Milbury Heath, Falfield, Glos. (Laid out Garden.)
No. 46.—John Jefferies & Son, Ltd., Royal Nurseries, Cirencester. (Rock and Water Garden.)
No. 51.—Stuart Low Co., Bush Hill Park, Enfield, Middlesex. (Orchids.)
No. 55.—Napiers, Stepswater Nurseries, Taunton. (Carnations.)
No. 63.—L. R. Russell, Ltd., Richmond Nurseries, Windlesham, Surrey. (Hardy Shrubs and Water Lilies.)
No. 69.—Toogood & Sons, Ltd., Southampton. (Cut Flowers.)
No. 72.—Edward Webb & Sons (Stourbridge), Ltd., Wordsley, Stourbridge. (Sweet Peas, Annuals and Pot Flowers.)

Silver-Gilt Medals to :—

No. 27.—Alpine Nurseries, Ltd., West Moors, Wimborne. (Rock and Alpine Plants.
No. 29.—Bees, Ltd., Sealand Nurseries, Chester. (Delphiniums and Lilies.)
No. 31.—H. A. Brown, 20, Chingford Mount Road, South Chingford, E.4. (Fuchsias.)
No. 32.—Benjamin R. Cant & Sons, Ltd., The Old Rose Gardens, Colchester. (Roses.)
No. 43.—Hewitt & Co., Banbury Road, Stratford-on-Avon. (Herbaceous Plants and Dahlias.)
No. 48.—Kelway & Son, Ltd., Langport, Somerset. (Pœnosis and Delphiniums.)
No. 53.—Maxwell & Beale, Ltd., Broadstone, Dorset. (Heath and Alpine Garden.)
No. 58.—M. Prichard & Sons, Ltd., Riverslea Nurseries, Christchurch, Hants. (Herbaceous Flowers.)
No. 64.—John Scott & Co., The Royal Nurseries, Merriott. (Flowering and Evergreen Trees, Shrubs, Herbaceous Flowers and Roses.)
No. 74.—White House Gardens, Llanfoist, Abergavenny. (Rock and Water Garden.)
No. 78.—C. Gregory, Old Close Nursery, Chilwell, Notts. (Roses.)

Silver Medals to :—

No. 36.—Daniels Bros., Ltd., Norwich. (Herbaceous Flowers, etc.)
No. 40.—G. Gibson & Co., The Great North Road Nurseries, Leeming Bar, Yorkshire. (Shrubs and Herbaceous Flowers.)
No. 42.—W. G. Haskins & Sons, Coy Pond Nurseries, Bournemouth, W. (Clematis Climbers and Flowering Shrubs.)
No. 45.—Hillier & Sons, West Hill Nurseries, Winchester. (Trees, Shrubs, etc.)
No. 49.—Horace Lakeman, Queensberry Nursery, Thornton Heath, Surrey. (Cut Border Carnations.)
No. 50.—G. F. Letts & Sons, Hadleigh, Suffolk. (Dwarf and Standard Polyantha Roses.)
No. 59.—R. W. Proctor & Sons, The Nurseries, Chesterfield. (Polyantha Roses.)
No. 60.—Redgrove & Patrick, Ltd., West Kent Nurseries, Sevenoaks. (Hardy Flowers and Rock Plants.)
No. 61.—F. Rich, Hindlip Nurseries, Worcester. (Hardy Cut Flowers.)
No. 62.—W. H. Rogers & Sons, Ltd., Red Lodge Nursery, Bassett, Southampton. (Alpines and Alpine Conifers.)
No. 66.—D. Stewart & Son, Ltd., Ferndown Nurseries, Ferndown, Wimborne. (Cut Flowers.)
No. 70.—William Treseder, Ltd., The Nurseries, Cardiff. (Shrubs, Roses, Flowers and Floral Designs.)
No. 73.—Wheatcroft Bros., Ltd., Ruddington, Nottingham. (New Roses.)
No. 76.—George E. P. Wood, Marsden Nursery, Ashtead, Surrey. (Alpine and Dwarf Herbaceous Plants and Belladonna Delphiniums.)
No. 77.—Jarman & Co., Chard. (Roses.)

FORESTRY.

No. 26.—Special Silver Gilt Medal for best general collection of exhibits to The Plymouth Estates, Ltd., St. Fagans, Cardiff.

The Prizes are First, Silver Medal; Second, Bronze Medal.

Class 1.—*Specimens of Oak, Elm, Ash, Spanish Chestnut, Sycamore and Beech Timber, or any of their varieties grown in Great Britain.*

1st, No. 2.—Major J. A. Herbert, M.P., Estate Office, Llanover, Abergavenny.
2nd, No. 1.—Capt. A. M. Talbot Fletcher, Saltoun Hall, East Lothian.

Class 2.—*Specimens of Larch, Silver Fir, Douglas, Spruce and Pine Timber.*

1st, No. 5.—Major J. A. Herbert, M.P., Estate Office, Llanover, Abergavenny.
2nd, No. 4.—Capt. A. M. Talbot Fletcher, Saltoun Hall, East Lothian.

Class 3.—*Oak Field Gate. The Gate must be made by the staff regularly employed on the Exhibitor's estate where the timber was grown.*

1st, No. 9.—Major J. A. Herbert, M.P., Estate Office, Llanover, Abergavenny.
2nd, No. 7.—Dinam Estates Company, The Offices, Llandinam, Mont.

Class 4.—*Field Gate for Farm use, of any other home-grown wood or combination of home-grown woods.*

1st, No. 13.—Major J. A. Herbert, M.P., Estate Office, Llanover, Abergavenny.
2nd, No. 11.—Dinam Estates Company, The Offices, Llandinam, Mont.

Class 5.—*Field Gate of rent or cleft Timber.*

[No Award.]

Class 6.—*Wicket or Hunting Gate (self-closing) manufactured from home-grown timber.*

1st, No. 19.—Major J. A. Herbert, M.P., Estate Office, Llanover, Abergavenny.
2nd, No. 18.—Capt. A. M. Talbot Fletcher, Saltoun Hall, East Lothian.

Class 7.—*Stile, to be made of home-grown timber. The Stile must be made by the staff regularly employed on the Exhibitor's Estate where the timber was grown.*

1st, No. 21.—Dinam Estates Company, The Offices, Llandinam, Mont.
2nd, No. 22.—Major J. A. Herbert, M.P., Estate Office, Llanover, Abergavenny.

Class 8.—*Field Fencing of home-grown wood, and made in Great Britain.*

1st, No. 24.—Dinam Estates Company, The Offices, Llandinam, Mont.

Class 9.—*Park and other Ornamental Fencing of home-grown wood, and made in Great Britain.*

[No Entry.]

Class 10.—*Forest Transplants and Seedlings.*

[No Entry.]

Non-Competitive Exhibits.

Silver Medals to :—

Plymouth Estates, Ltd., St. Fagans, Cardiff.
Robert Neil Chrystal, M.A., D.Sc., Imperial Forestry Institute, University of Oxford.
The Duke of Montrose, Brodrick Castle, Isle of Arran.
Long Ashton Research Station, University of Bristol, Long Ashton, Bristol.
Department of Botany, National Museum of Wales, Cardiff.
Royal Agricultural College, Cirencester.
Timber Development Association, Ltd., Equitable House, 47/51, King William Street, London, E.C.4.

Bronze Medal to :—

R. C. B. Gardner, Conington Hall, Cambridge.

GATE MAKING COMPETITION.

1st, £5. No. 2.—Llanover Estate, Estate Office, Llanover, Abergavenny (J. Jones and G. Stinchcombe).
2nd, £3. No. 1.—Dinam Estate, The Offices, Llandinam, Mont (Pryce Woosencroft and Richard Corfield).

WOODLANDS, PLANTATIONS AND ESTATE NURSERIES COMPETITION.

Confined to North Wales.

The Royal English Forestry Society's Gold Medal for the best Plantation entered in Classes I. to V.:—
The Earl of Powis (Dinger's Wood).

I.—*Where Hardwoods are intended as the final crop.*

Class (a).—*Planted from 10 to 25 years.*

1st, Silver Medal.—The Earl of Powis, Powis Castle, Welshpool (Dinger's Wood).
2nd, Bronze Medal.—C. P. Ackers, Huntley Manor, Gloucester (Leighton, Welshpool), (Park Wood Plantation).

Class (b).—*Over 25 years of age.*

1st, Silver Medal.—C. P. Ackers, Huntley Manor, Gloucester (Leighton, Welshpool) (Pentri Mill Plantation).
2nd, Bronze Medal.—Lord Penrhyn, Penrhyn Castle, Bangor (Laundry Wood and Bath Wood).

II.—*Where the final crop is intended to be Conifers, viz., Douglas Fir, Sitka Spruce, Norway Spruce, Japanese Larch, European Larch, Corsican Pine, Scots Fir, whether in single varieties or mixed.*

Class (a).—*Planted from* 10 *to* 20 *years.*

1st, Silver Medal.—C. P. ACKERS, Huntley Manor, Gloucester (Leighton Welshpool), (Pole Cover Plantation).
2nd, Bronze Medal.—THE EARL OF POWIS, Powis Castle, Welshpool (Talyrnan Cross).

Class (b).—*Over* 20 *years of age.*

1st, Silver Medal.—C. P. ACKERS, Huntley Manor, Gloucester (Leighton Welshpool), (Roundabout Plantation).
2nd, Bronze Medal.—THE EARL OF POWIS, Powis Castle, Welshpool (Watery Lane).

III.—*Where the intention is to have a Mixed Wood of Hardwoods and Conifers.*

Class (a).—*Planted from* 10 *to* 20 *years.*

[NO ENTRY.]

Class (b).—*Over* 20 *years of age.*

1st, Silver Medal.—C. P. ACKERS, Huntley Manor, Gloucester (Leighton Welshpool), (Pentri Mill Plantation).
2nd, Bronze Medal.—LORD PENRHYN, Penrhyn Castle, Bangor (Tryngwyn Plantation).

IV.—*Plantations of not less than one acre, consisting of any Conifer not specified in* **Class II,** *planted not less than* 5 *years.*

1st, Silver Medal.—C. P. ACKERS, Huntley Manor, Gloucester (Leighton, Welshpool), (Chimneypiece).
2nd, Bronze Medal.—C. P. ACKERS, Huntley Manor, Gloucester (Leighton, Welshpool), (Greenwood).

V.—*For the best managed Coppice or Coppice with Standards to include not less than three "falls" of different age and each of which is not less than one acre in extent.*

[NO ENTRY.]

VI.—*For the best managed Estate Nursery.*

1st, Silver Medal.—LORD PENRHYN, Penrhyn Castle, Bangor.
2nd, Bronze Medal.—THE EARL OF POWIS, Powis Castle, Welshpool.

VII.—*For the Best Managed Woodlands on an Estate of not less than* 1,000 *acres (the whole estate must be entered and its area stated), the Judges to take into account examples of systematic management for the production of timber, as well as ornamental planting, planting for sporting purposes, and improvement of residential amenities.*

1st, Special Silver Gilt Medal.—THE EARL OF POWIS, Powis Castle, Welshpool.
2nd, Silver Medal.—LORD PENRHYN, Penrhyn Castle, Bangor.
3rd, Bronze Medal.—SIR EDWARD NAYLOR-LEYLAND, Bt., Nantclwyd Hall, Ruthin.

YOUNG FARMERS' CLUB SECTION.

Classes 1, 2, 3, 5 *and* 6 *open only to members of the Young Farmers' Clubs in Wales and Monmouthshire.*

Classes 4, 7 *and* 8 *open to members of the Young Farmers' Clubs in England and Wales.*

The Prizes are as follows:—**1st, 40s.; 2nd, 30s.; 3rd, 20s.; 4th, 15s.; 5th, 10s.; 6th, 5s.**

Class 1.—*Dairy Heifer, any Breed or Cross, born on or between October* 1*st,* 1936 *and March* 31*st,* 1937.

1st & Res. Champion, No. 7.—**K. G. G. WEEKES, The Village Farm,** Penhow, Newport, (Shorthorn.)
2nd, No. 5.—LEONARD HAWKINS, **Tredomen Farm, Mamhilad,** Pontypool. (Shorthorn.)

3rd, No. 4.—PHILLIP JONES, Lower Stanton, Crucorney Fawr, Abergavenny, **Mulbre.** (Shorthorn).
4th, No. 1.—BRENIG THOMAS, Cwmcamlus Isaf, Sennybridge. (Shorthorn.)
5th, No. 2.—KEN DAVIES, Penishaplwydd Farm, Pandy, Abergavenny, **Millie.** (Shorthorn.)
6th, No. 3.—TREVOR DAVIES, Penyclawdd Court, Cucorney Fawr, Abergavenny, **Heather.** (Shorthorn.)
R.N. No. 13.—ELUNED MORGAN, Felindre West, St. Nicholas, Goodwick, **Bounty.** (Shorthorn.)

Class 2.—*Dairy Heifer, any Breed or Cross, born on or between April 1st and June 30th,* 1937.

1st, & Champion, No. 15.—MARGARET DAVID, Longlands Farm, Kenfig Hill, **Nelly Bly.** (Shorthorn.)
2nd, No. 18.—JOHN HOPPER, Balas Cottage, Pyle, Bridgend, **Daisy.** (Shorthorn.)
3rd, No. 17.—GRACE JONES, Parc Newydd, Pyle, Bridgend, **Shan.** (Shorthorn.)
4th, No. 14.—MILDRED LEWIS, Hendredenny Uchaf, Caerphilly, **Toots.** (Shorthorn.)
5th, No. 16.—DAVID JONES, Parc Newydd Farm, Pyle, Bridgend, **Daisy.** (Shorthorn.)
6th, No. 21.—IRIS DAVIES, Lower Monkton Farm, Wick, Cowbridge. (Shorthorn.)
R.N. No. 23.—R. S. HOPKINS, Plant Farm, Newbridge, **Beauty.** (Shorthorn.)

Class 3.—*Dairy Heifer, any Breed or Cross, born on or after July 1st,* 1937.

1st, No. 29.—WALTER EVANS, Cefn Onn, Rudry, Caerphilly, **Lily.** (Shorthorn.)
2nd, No. 25.—BRENIG THOMAS, Cwmcamlais Isaf, Sennybridge. (Shorthorn.)
3rd, No. 24.—ELFED JONES, Pencroesffyrdd, Cray, **Fanny.** (Shorthorn.)
4th, No. 30.—WALTER EVANS, Cefn, Onn, Rudry, Caerphilly, **Peggy.** (Shorthorn.)
5th, No. 35.—K. G. G. WEEKES, The Village Farm, Penhow, Newport. (Shorthorn.)
6th, No. 31.—EWART EDMUNDS, Ty Isaf Farm, Caerphilly, **Juliana.** (Friesian.)
R.N. No. 32.—ELWYN MORRIS, Tycanol Farm, Caerphilly. (Friesian-Ayrshire cross.)

Class 4.—*Club Team of Three Dairy Calves, any Breed or Cross, born on or after October 1st,* 1936.

1st, No. 38.—MARGAM YOUNG FARMERS' CLUB.
2nd, No. 36.—CAERPHILLY YOUNG FARMERS' CLUB.
3rd, No. 37.—CUCORNEY FAWR YOUNG FARMERS' CLUB.
4th, No. 41.—USK YOUNG FARMERS' CLUB.

Class 5.—*Beef Heifer or Steer, any Breed or Cross, born on or between January 1st and June 30th,* 1937.

1st, No. 48.—A. BEVAN, Reynish House, Wolfsdale, Camrose. (Hereford.)
2nd, No. 45.—T. GLYN EVANS, Broughton House, Wick, Cowbridge. (Hereford.)
3rd, No. 49.—W. DAVIES, Mymaston Farm, Haverfordwest. (Cross-bred.)
4th, No. 50.—R. PHILLIPS, Rinaston, Treffgarne. (Hereford.)
5th, No. 44.—DANIEL J. EVANS, Broughton House, Wick, Cowbridge. (Hereford.)
6th, No. 47.—JOHN E. PRICE, Cophill, Chepstow, **Janet.** (Hereford.)
R.N. No. 46.—THOMAS W. SMITH, Hardwick Farm, Caerwent, Chepstow. (Hereford.)

Class 6.—*Beef Heifer or Steer, any Breed or Cross, born on or after July 1st,* 1937.

1st, No. 53.—CERIDWEN PRICE, Tanyfedw, Sennybridge. (Hereford.)
2nd, No. 52.—DAVID ALUN PRICE, Tanyfedw, Sennybridge. (Hereford.)
3rd, No. 51.—OWEN JOHN PRICE, Tanyfedw, Sennybridge, (Hereford-Shorthorn-cross.)
4th, No. 54.—WILLIAM JOHN JAMES, Cefn Mawr Farm, Monkswood, Usk, **Tulip.** (Hereford.)

Class 7.—*Beef Heifer or Steer, any Breed or Cross, born on or after October 1st,* 1936.

1st, No. 48.—A. BEVAN, Reynish House, Wolfsdale, Camrose. (Hereford.)
2nd, No. 49.—W. DAVIES, Mymaston Farm, Haverfordwest. (Cross-bred.)
3rd, No. 50.—R. PHILLIPS, Rinaston, Treffgarne. (Hereford.)
4th, No. 55.—KATHLEEN HEATH, Llan-y-nant, Trelleck Grange, Chepstow, **Dinah.** (Hereford.)
5th, No. 47.—JOHN E. PRICE, Cophill, Chepstow, **Janet.** (Hereford.)
6th, No. 54.—WILLIAM JOHN JAMES, Cefn Mawr Farm, Monkswood, Usk, **Tulip.** (Hereford.)

Class 8.—*Club Team of Three Beef Calves, Heifers or Steers, any Breed or Cross, born on or after October 1st,* 1936.

1st, No. 59.—HAVERFORDWEST & DISTRICT YOUNG FARMERS' CLUB.
2nd, No. 58.—CRAY YOUNG FARMERS' CLUB.
3rd, No. 57.—CHEPSTOW & DISTRICT YOUNG FARMERS' CLUB.

DISTRICT CLASSES.

Open to Exhibitors resident in the Counties of Brecon, Cardigan, Carmarthen, Glamorgan, Monmouth, Pembroke and Radnor.

Colliery Horses.

Class 1.—*Colliery Horse, Mare or Gelding, not exceeding* 14 *hands, most suitable for underground work. Age not less than* 3 *years.*

1st, £4, No. 9.—POWELL DUFFRYN ASSOCIATED COLLIERIES, LTD., Ystrad Mynach, Glam., **The Gaffer.**
2nd, £3, No. 8.—POWELL DUFFRYN ASSOCIATED COLLIERIES, LTD., Ystrad Mynach, Glam., **Andy.**
3rd, £1, No. 6.—W. J. MADDOCK, Cefnydfa Farm, Tondu, Bridgend, **Playboy.**
R.N. No. 1.—C. L. CLAY & CO., LTD., Merthyr House, Cardiff, **Rhigos Cruiser.**

Class 2.—*Colliery Horse, Mare or Gelding, not exceeding* 14·3 *hands, most suitable for underground work. Age not less than* 3 *years.*

1st, £4, No. 19.—WILLIAM JOHN THOMAS, Cawdor Cottage, Llandilo, Carms., **Cawdor's Model.**
2nd, £3, No. 18.—POWELL DUFFRYN ASSOCIATED COLLIERIES, LTD., Ystrad Mynach, Glam., **Justice.**
3rd, £1, No. 17.—POWELL DUFFRYN ASSOCIATED COLLIERIES, LTD., Ystrad Mynach, Glam., **Captain.**
R.N. No. 14.—EVANS & BEVAN, LTD., Neath, Glam., **Bantam.**

Class 3.—*Colliery Horse, Mare or Gelding, not exceeding* 15·1 *hands, most suitable for underground work. Age not less than* 3 *years.*

1st, £4, No. 33.—POWELL DUFFRYN ASSOCIATED COLLIERIES, LTD., Ystrad Mynach, Glam., **Penallta Emperor.**
2nd, £3, No. 28.—DAVID MORGAN, Maesteilo, Cimla, Neath, Glam., **Silver King.**
3rd, £1, No. 36.—G. C. WADSWORTH, Pandy Farm, St. Mellons, Mon., **Cawdor Pride.**
R.N. No. 32.—POWELL DUFFRYN ASSOCIATED COLLIERIES, LTD., Ystrad Mynach, Glam., **Justice.**

Class 4.—*Colliery Horse, Mare or Gelding, any height, that has worked underground for a period of three months prior to July 1st,* 1938.

1st, £4, No. 52.—POWELL DUFFRYN ASSOCIATED COLLIERIES, LTD., Ystrad Mynach, Glam., **Penallta Emperor.**
2nd, £3, No. 53.—POWELL DUFFRYN ASSOCIATED COLLIERIES, LTD., Ystrad Mynach, Glam., **The Gaffer.**
3rd, £1, No. 51.—POWELL DUFFRYN ASSOCIATED COLLIERIES, LTD., YSTRAD MYNACH, Glam., **Justice.**
R.N. No. 47.—POWELL DUFFRYN ASSOCIATED COLLIERIES, LTD., Ystrad Mynach, Glam., **Don.**

Horses.

Class 5.—*Agricultural Mare or Gelding, the property of a Farmer who obtains his living solely on the land.*

[Cancelled.]

Timbering and Steel Arching.

(Confined to Underground Workmen.)

Prizes offered by Monmouthshire and South Wales Coal Owners' Association.

Class 6.—*Erection of a Group of Four Steel Arches with Manhole. Team of three men. Confined to Underground Workmen.*

1st, £7 10s., No. 5.—OWEN ROWLANDS, 53, Margaret Street, Ammanford. Assistants—Thomas Rowlands and David B. Rowlands.
2nd, £6, No. 3.—WILLIAM D. HUGHES, 1, Laing Street, Kenfig Hill, Glam. Assistants—William Morries and William Ansen.
3rd, £4 10s., No. 1.—ROBERT GRIFFITHS, 82, John Street, Nantymoel, Glam. Assistants—John Richards and Griffith Rees.

Class 7.—Erection of a Pair of Timbers, Level Road Flat Seam. Confined to Collier and his Helper.

1st, £5, No. 6.—WILLIAM BOWEN, 4, Kensington Terrace, Pontyberem (Collier). Helper—Edward A. Bowen.
2nd, £4, No. 13.—B. S. THOMAS, Golden Lion, Lower Cwmtwrch, Swansea (Collier). Helper—D. W. Thomas.
3rd, £3, No. 7.—EDGAR EVANS, 4, Armoury Terrace, Osborne Road, Pontypool, Mon. (Collier). Helper—Ernest Amos.

Class 8.—*Erection of a Pair of Timbers, Level Road Flat Seam. Confined to Repairer or Contractor and his Helper.*

1st, £5, No. 23.—OWEN ROWLANDS, 53, Margaret Street, Ammanford (Repairer). Helper—Thomas Rowlands.
2nd, £4, No. 16.—DAVID BOWEN, Northampton Place, Garnant, Ammanford (Repairer). Helper—John Thomas.
3rd, £3, No. 24.—TOM ROWLANDS, Oak Villa, Carway, near Kidwelly, Carms. (Repairer). Helper—William Gravell.

LOCAL CLASSES.

Open to Exhibitors resident in the Counties of Glamorgan and Monmouth.

Children's Riding Pony.

Class 9.—*Pony, Mare or Gelding, not exceeding* 12·2 *hands, to be ridden by a child not over* 12 *years of age on 9th July,* 1938.

1st, £3, No. 58.—NEVILLE BUDGEN, Llandaff, Cardiff, **June.**
2nd, £2, No. 68.—MATTHEW WILLIAMS, Brynheulog, Tonteg, Llantwit Fardre, Glam., **Silver Mint.**
3rd, £1, No. 62.—THOMAS JENKINS, Lynwood, Pontyclun, Glam., **The Dawn.**
4th, 10s., No. 61.—JOHN A. IRVING, 41, Thornhill Road, Llanishen, Cardiff, **Jean of Galloway.**
R.N. No. 59.—PAT BURCHER, 69, Caerlon Road, Newport, Mon., **Craven Frandda.**

Class 10.—*Pony, Mare or Gelding, not exceeding* 14·2 *hands, to be ridden by a child not over* 16 *years of age on 9th July,* 1938.

1st, £3, No. 69.—NEVILLE BUDGEN, Llandaff, Cardiff, **Roseleaf.**
2nd, £2, No. 71.—FREDERICK DEVEREUX, Riding School, Llanishen, Cardiff, **Geisha.**
3rd, £1, No. 75.—ANNE MORGAN, Gadairwen Farm, Croesfaen, Pontyclun, Glam., **Sunbeam.**
4th, 10s., No. 70.—MURIEL BURCHER, 69, Caerleon Road, Newport, Mon., **Senni.**
R.N. No. 74.—THOMAS JENKINS, Lynwood, Pontyclun., Glam., **The Gent.**

Harness.

Prizes offered by Cardiff and District May Horse Show Society.

Class 11.—*Stallion, Mare or Gelding, not exceeding* 14 *hands.*

1st, £5, No. 78.—C. H. LOWE, 7, Corporation Road, Cardiff, **Braishfield Royal Blue.**
2nd, £3, No. 79.—THOMAS I. MATHIAS, Cimla, Neath, **Military.**
3rd, £2, No. 76.—J. & J. E. HOURAHANE, 54, Arabella Street, Cardiff, **April Showers.**

Class 12.—*Stallion, Mare or Gelding, exceeding* 14 *hands.*

1st, £5 & Cup, No. 82.—D. REES JONES & SON, Penbryn Hackney Stud, Aberdare, Glam., **Penbryn Modern Knight.**
2nd, £3 & R.N. for Cup, No. 84.—DAVID REES (LLWYNYGRANT), LTD., Llwynygrant Dairy Cyncoed Road, Penylan, Cardiff, **Nomination.**
3rd, £2, No. 83.—MERRETT'S LTD., Graham Buildings, Newport Road, Cardiff, **Graham Sunshine.**
R.N. No. 81.—HARRY HORRELL, Cross Farm Dairy, Village Road, Rumney, Cardiff, **Rumney Dairy-Maid.**

Rope Splicing and Capping.

Prizes offered by D. Morgan Rees & Sons, Ltd., Whitchurch, Cardiff.

Class 13.—*Rope Splicing. Team of three men (one Leader and two Assistants); ¾ inch diameter haulage rope. Lenth of splice 30 feet. Time allowed 45 minutes.*

1st, £4, No. 28.—Thomas John Hughes, 46, Villiers Road, Blaengwynfi, Port Talbot, Glam. (Leader). Assistants—Oliver Richard James and David Arthur Jones.
2nd, £2, No. 29.—Mark Wilkinson Turner, 14, Vale View, Tredegar, Mon. (Leader). Assistants—Edgar George and Norman Turner.
3rd, £1, No. 27.—Robert Elliott, 3, Church Street, Cwmgorse, Gwauncaegurwen, Ammanford (Leader). Assistants—Vincent Evans and Albert Hawker.

Class 14.—*Rope Capping. Team of two men. Complete fitting of open type Cap to ¾ inch diameter haulage rope. No time limit.*

1st, £3, No 31.—Stan Horler, 8, Collwyn Road, Pyle, Glam. Assistant—H. Bluck.
2nd, £2, No. 30.—Robert Elliott, 3, Church Street, Cwmgorse, Gwaencaegurwen, Ammanford. Assistant—Vincent Evans.

Prizes in Classes 15 *and* 16 *offered by Messrs. British Ropes, Ltd., Excelsior Wire Rope Works, Cardiff.*

Class 15.—*Rope Splicing. Team of three men. Long Splice ¾ inch diameter Flattened Strand Rope. Length of splice* 24 *feet. No time limit.*

1st, £4, No. 32.—Rees Davies, 36, Upper Colbren Road, Gwauncaegurwen, Ammanford. Assistants—Rees Griffiths and Stanley Jones.
2nd, £2, No. 36.—Mark Wilkinson Turner, 14, Vale View, Tredegar, Mon. Assistants—Edgar George and Norman Turner.
3rd, £1, No. 34.—Stan Horler, 8, Collwyn Road, Pyle, Glam. Assistants—D. Jones and H. Bluck.
R.N. No. 33.—Robert Elliott, 3, Church Street, Cwmgorse, Gwauncaegurwen, Ammanford. Assistants—Vincent Evans and Albert Hawker.

Class 16.—*Rope Splicing. One man. Splice heart-shaped thimble into ¾ inch diameter Flexible Engineering Rope. Splice to be prepared but not served over. Time limit, one hour.*

[No Entry.]

Trade Turnouts.

Prizes offered by Cardiff and District May Horse Show Society. Open to Exhibitors resident within a radius of six miles of the City Hall, Cardiff.

Light Trade Harness.

Class 17.—*Mare or Gelding, not exceeding* 12·2 *hands.*

1st, £5, No. 92.—Albert Ronald Wall, 63, Severn Road, Cardiff, **Fleetfoot Flapper.**
2nd, £3, No. 90.—Harry Parfitt, 1, Norman Street, Cathays, Cardiff, **Grey Light.**
3rd, £2, No. 91.—Walter Vickery, 34, Cross Road, Maindy, Cardiff, **May Queen.**
R.N. No. 88.—W. Moffatt, 108, Brunswick Street, Cardiff, **Dolly.**
H.C. No. 89.

Class 18.—*Mare or Gelding, over* 12·2, *and not exceeding* 14 *hands.*

1st, £5, No. 96.—Frank Wellbeloved, 131, Moy Road, Cardiff, **Nipper.**
2nd, £3, No. 93.—G. Legge & Sons, Tynycoed, Pantbach Road, Whitchurch, Glam., **Pocket Hercules.**
3rd, £2, No. 95.—H. G. Vincent, Sunnybank Dairy, Rumney, Cardiff, **Miss Muffet.**

Class 19.—*Mare or Gelding, exceeding* 14 *hands.*

1st, £5, No. 101.—Merrett's, Ltd., Graham Buildings, Newport Road, Cardiff, **Graham Sunshine.**
2nd, £3, No. 102.—George Miles, 43, Pill Street, Cogan, Penarth, Glam., **Buddy.**
3rd, £2, No. 98.—Harry Horrell, Cross Farm Dairy, Village Road, Rumney, Cardiff, **Rumney Dairy Maid.**
R.N. No. 99.—Percy Jenkins, 31, Caroline Street, Cardiff, **Queen.**

Heavy Trade Harness.

Class 20.—*Heavy Draught Mare or Gelding.*

1st, £5, No. 107.—WM. HANCOCK & CO., LTD., The Brewery, Cardiff, **Coronation King.**
2nd, £3, No. 108.—JOHN H. MOON, Hope Street, Cardiff, **Forest King.**
3rd, £2, No. 106.—WM. HANCOCK & CO., LTD., The Brewery, Cardiff, **Amber Prince.**
R.N. No. 104.—GREAT WESTERN RAILWAY COMPANY, Cardiff, **Carman Morris.**
H.C. Nos. 103, 109. C. No. 105.

Class 21.—*Medium Draught Mare or Gelding.*

1st, £5, No. 110.—F. BOWLES & SON, Harrowby Street, Cardiff, **Captain.**
2nd, £3, No. 113.—GREAT WESTERN RAILWAY COMPANY, Cardiff, **Carman Baker.**
3rd, £2, No. 118.—JOHN H. MOON, Hope Street, Cardiff, **May Flower.**
R.N. No. 116.—WM. HANCOCK & CO., LTD., The Brewery, Cardiff, **Cooper.**
H.C. Nos. 114, 120, 121. C. No. 111.

Class 22.—*Vanner Mare or Gelding.*

1st, £5, No. 128.—JOHN H. MOON, Hope Street, Cardiff, **May Queen.**
2nd, £3, No. 127.—WM. HANCOCK & CO., LTD., The Brewery, Cardiff, **Prince.**
3rd, £2, No. 132.—THOMAS & EVANS, LTD., Porth, Glam., **Corona.**
R.N. No. 125.—WM. HANCOCK & CO., LTD., The Brewery, Cardiff, **Dandy.**
H.C. Nos. 129, 130. C. Nos. 133, 134.

Class 23.—*Heavy Draught Team or Tandem.*

1st, £5, No. 137.—WM. HANCOCK & CO., LTD., The Brewery, Cardiff, **Jubilee Lad** and **Tinker.**
2nd, £3, No. 140.—JOHN H. MOON, Hope Street, Cardiff, **Forest King** and **Heathfield Squire.**
3rd, £2, No. 138.—WM. HANCOCK & CO., LTD., The Brewery, Cardiff, **Lion** and **Duke.**
R.N. No. 135.—GREAT WESTERN RAILWAY COMPANY, Cardiff, **Carman Morris** and **Carman Osman.**

Butter.

(*Prizes offered by Glamorgan Agricultural Committee.*)

Class 24.—*Two Pounds of Fresh or very slightly Salted Butter, made by Exhibitors who have taken a Course of Instruction at the Glamorgan County Travelling Dairy School.*

1st, £2, No. 95.—MISS MAY ESCOTT, Brooklands, Wick, Cowbridge.
2nd, £1, No. 94.—MISS ANNIE J. DAVIES, Highway Villa, Parkmill, Swansea.
3rd, 10s., No. 96.—MISS EVA WILLIAMS, Cae-Caradog Farm, St. Bride's Major, Bridgend.

Class 25.—*Two Pounds of Fresh or very slightly Salted Butter, made by Exhibitors who have taken a Course of Instruction at the Glamorgan Central Dairy School.*

1st, £2, No. 97.—MISS MAY ESCOTT, Brooklands, Wick, Cowbridge.
2nd, £1, No. 100.—MRS. J. C. REES, Iona, Brynteg Gardens, Bridgend.
3rd, 10s., No. 99.—MISS MARY LLEWELLYN, Old Beaupre Farm, Cowbridge.
4th, 5s., No. 98.—MISS A. W. JAMES, Sheepcourt, Bonvilston, Glam.

Cheese.

(*Prizes offered by Glamorgan Agricultural Committee.*)

Class 26.—*Three Caerphilly Cheeses (not less than 4 lb. and not more than 6 lb. each), made in the year 1938 by Exhibitors who have taken a Course of Instruction provided by the Glamorgan Agricultural Committee.*

1st, £2, No. 209.—MRS. J. C. REES, Iona, Brynteg Gardens, Bridgend.
2nd, £1, No. 208.—MRS. DILWYN T. JONES, Plasnewydd, Llantwit Major.
R.N. No. 210.—MISS C. THOMAS, Great House Farm, Llanmaes, Llantwit Major.

Class 27.—*Three Caerphilly Cheeses (over 6 lb. each), made in the year 1938 by Exhibitors who have taken a Course of Instruction provided by the Glamorgan Agricultural Committee.*

1st, £2, No. 214.—MISS C. THOMAS, Great House Farm, Llanmas, Llantwit Major.
2nd, £1, No. 213.—MRS. DILWYN T. JONES, Plasnewydd, Llantwit Major.
3rd, 10s., No. 216.—MISS EVA WILLIAMS, Cae-Caradog Farm, St. Bride's Major, Bridgend.

Butter.

(Prizes offered by Monmouthshire County Council Agricultural Education Department.)

Class 28.—*Two Pounds of Fresh or very slightly Salted Butter from the milk of Channel Island Breeds of Cattle and their Crosses.*

1st, £2, No. 101.—MISS RACHEL JAMES, Llancayo, Usk, Mon.

Class 29.—*Two Pounds of Fresh or very slightly Salted Butter from the milk of Cattle of any Breed or Cross other than Channel Island Breeds of Cattle.*

1st, £2, No. 102.—MISS RACHEL JAMES, Llancayo, Usk, Mon.
2nd, £1, No. 103.—MRS. J. T. ROGERS, Llanwinney Farm, Llangovan, Monmouth.
3rd, 10s., No. 104.—MISS J. F. M. WILLIAMS, The Homestead, Llangovan, Monmouth.

Class 30.—*Two Pounds of Salt Butter from the milk of Channel Island Breeds of Cattle and their Crosses.*

[No Entry.]

Class 31.—*Two Pounds of Salt Butter from the milk of Cattle of any Breed or Cross other than Channel Island Breeds of Cattle.*

1st, £2, No. 105.—MRS. J. T. ROGERS, Llanwinney Farm, Llangovan, Monmouth.

Cheese.

(Prizes offered by Monmouthshire County Council Agricultural Education Department.)

Class 32.—*Two Caerphilly Cheeses, not more than 7 lb. each.*

1st, £2, No. 218.—MISS HILDA E. MESSENGER, Kemeys Commander, Usk, Mon.
2nd, £1, No. 217.—MISS RACHEL JAMES, Llancayo, Usk, Mon.

Class 33.—*Two Cheddar Truckles, not more than 10 lb. each.*

1st, £2, No. 219.—MISS HILDA E. MESSENGER, Kemeys Commander, Usk, Mon.

IMPLEMENTS.

Silver Medals for New Implements :—

No. 63.—COOCH & SON, Commercial Street, Northampton, for Potato Sorting Table with Roller Conveyor.
No. 136.—JOHN H. DARBY, Hillmorton, Rugby, for Thatching Needle.
No. 432.—BAMFORD'S LTD., Uttoxeter, for Artificial Manure Distributor.

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——— Grass Drying Progress. A Study of Production Costs in 1937. By R. N. Dixey and W. F. Darke .. .. *Director*

——— Milk Investigation Scheme. Costs of Production in England and Wales. Interim Reports: No. 1, November 1st, 1934 to September 30th, 1935. No. 2, October 1st, 1935 to September 30th, 1936 .. .. *Director*

——— Miscellaneous Papers, Vol. VIII, 1935–38. Oxford, 1938 .. .. *Director*

AGRICULTURAL RESEARCH COUNCIL. Constitution and Functions of the Council. London, 1937 .. .. *Council*

——— Dairy Research. London, 1938 .. .. .. *Council*

ASSOCIATED COUNTRY WOMEN OF THE WORLD. Proceedings of Third Triennial Conference held at Washington, 1936 *U.S. Governmen*

BORON AGRICULTURAL BUREAU. Boron Deficiency in Horticultural Crops. Recent Developments. By A. W. Greenhill. Reprinted from "Scientific Horticulture," Vol. VI, 1938 *Bureau*

BRANDT, KARL. The German Fat Plan and its Economic Setting. Food Research Institute, Stanford University, California, 1938 .. .. *Institute*

BRITISH AGRICULTURE. The Principles of Future Policy. A Report of an Enquiry by VISCOUNT ASTOR and B. SEEBOHM ROWNTREE. London, 1938 .. .. *Purchased*

CAMBRIDGE UNIVERSITY DEPARTMENT OF AGRICULTURE. Farm Economics Branch, Report No. 24, Changes in the Economic Organization of Agriculture. A Comparative Study of Conditions in the Eastern Counties of England in 1935 and 1936. Cambridge, 1937 .. .. *Purchased*

CULPIN, C. Farm Machinery. London, 1938 .. .. *Purchased*

ENGLISH GUERNSEY CATTLE SOCIETY. Judging Guernsey Cattle. By D. C. Bower. (*Pamphlet*, 1938) .. .. .. *Society*

ERNLE, LORD. Whippingham to Westminster. The Reminiscences of Lord Ernle (Rowland Prothero). With an Introduction by Lord Kennet and a concluding Note by Sir A. Daniel Hall. London, 1938 .. .. *Purchased*

GINEITIS, KAZYS. Lithuanian Quality Products, Bacon, Butter, Poultry, Eggs, etc. A record of agricultural progress *Author*

Grassland Congress (Fourth International), Great Britain, 1937. Report containing full texts of all Papers delivered to the Congress at Aberystwyth, July, 1937 .. .. *Committee*

Hamilton, Sir Ian. Belted Galloways. 2nd Ed. London, 1938 *Purchased*

Imperial Economic Committee. Annual Reviews: Fruit Supplies, 1937; Dairy Produce Supplies, 1937; Wool Production and Trade, 1937–38; World Consumption of Wool, 1937.

——— Summaries of figures of Production and Trade: Meat; Fruit; Grain Crops; Industrial Fibres; Dairy Produce; Vegetable Oils and Oilseeds.

——— Apples and Pears. A Survey of Production and Trade in British Empire and Foreign Countries .. .. *Purchased*

Imperial Forestry Institute. The Black Poplars and their Hybrids cultivated in Great Britain. By G. S. Cansdale and Members of the staff of the Institute. Oxford, 1938 *Institute*

Journal of Agricultural Science, Vol. XXVIII. Cambridge, 1938 .. .. *Purchased*

Lincoln Longwool Sheep Breeders' Association. Brief History of Lincoln Longwool Sheep from the year 1750. (*Pamphlet*, 1938) .. .. *Association*

Link, Pablo. Razas Ovinas. Buenos Aires, 1937 .. .. *Author*

Lymington, Viscount. Famine in England. London, 1938 *Purchased*

Massee, A. M. The Pests of Fruit and Hops. London, 1937 *Purchased*

Ministry of Agriculture and Fisheries. Handbook of Acts and Orders relating to Diseases of Animals. London, 1937 *Purchased*

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